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USSR Report

TRANSPORTATION

No. 105

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This serial report contains information on plans and the performance of the national transportation system. Included are the rail, water, air, and highway systems; the construction, operation, maintenance, and equipment of these systems; and the application of new technology to transportation problems.

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CONTENTS

MEASURES TO INCREASE MILK DELIVERY EFFICIENCY

Alma-Ata NARODNOYE KHOZYAYSTVO KAZAKHSTANA in Russian No 9, Sep 82 pp 35-38

[Article by Associate Professor M. Shchipunov, Tselinograd Engineering Construction Institute: "An Important Factor to Reduce Milk Losses"]

> [Text] "During the 12th Five-Year Plan, it is planned to complete conversion to acceptance of cattle, poultry, milk, potatoes, vegetables, fruits and berries directly on the kolkhozes and sovkhozes to more fully utilize the grown and cultivated product and to preserve and process it completely. This product will be transported by the procurement organizations." L. I. Brezhnev, report to the May (1982) Plenum of the CPSU Central Committee.

Implementation of the Supply program requires accelerated development of agriculture-related sectors, on which the preservation of products and rapid delivery of it to the consumer largely depends. For example, the quality of milk and dairy products is most closely related to reduction of transport losses. Development of large livestock complexes and milk-production farms makes it possible to apply methods of product shipments and to reduce transport and procurement expenses.

The most promising is centralized export, which guarantees acceptance of milk at the points of production, which makes it possible to free the sovkhozes and kolkhozes of transportation concerns. These functions have been entrusted to specialized motor transport enterprises of Minmyasomolprom [KASSR Ministry of the Meat and Dairy Industry]. However, the simple formality of transfer of affairs will not work; fundamental readjustment of the operation of all organizations related to shipments is required. And this should be accomplished on a scientific basis.

Transport of milk--a rather "perishable" product--has its own characteristics: the producing farms are usually located far from each other, the productivity of complexes and farmsteads is not equivalent in capacities and by seasons, any type of truck is not suitable, but only a specialized type of truck is required for shipments. But before milk is delivered to the tank, it should be cooled and purified. Its quality largely depends on the condition of roads and approaches to the farmsteads and even the training level of the drivers who know how to make a reliable determination of the required product parameters.

A constant increase of milk production is planned by the provisions program. Thus, the average annual milk production throughout our republic must be guaranteed at 4.9-5 million tons during the 11th Five-Year Plan and 5.3-5.4 million tons during the 12th Five-Year Plan.

Accordingly, the loads on transport will increase and this means that the role of centralized hauling will be intensified.

Analysis of the operation of production associations of the republic's dairy industry in centralization of milk shipments during 1981 (from data of the Kazmyasomoltrans Administration [KAZSSR Meat and Milk Transport Administration] shows that 536,800 tons (22.6 percent) of 2.377 million tons of milk procured were transported by the centralized method. And only 459,100 tons was transported by the progressive method during 1979, which comprised 20.5 percent of the procured amount. The increase is insignificant--68,800 tons. In 1981, 449 tank trucks with an average capacity of 3.4 tons (total tonnage of 1,526 tons) were engaged in centralized transport.

Hence, it is clear that the output of tank trucks is low (352 tons per year per registered truck-ton). At the same time this indicator in the leading collectives of the Kazmyasomoltrans system is considerably higher. For example, 53,900 tons or 31.3 percent (485 tons per truck-ton) of milk of the procured 172,200 tons was transported by the centralized method in the Alma-Ata Dairy Association.

From the given examples it is obvious that introduction of the progressive method of centralized transport in the republic is still unsatisfactory. The Kustanay Dairy Association is especially lagging behind. A total of 19,000 tons (5.4 percent) of 354,300 tons of procured milk was transported by the centralized method and the output per registered truck-ton was 321 tons per year. Centralized transport tolerated losses of 20,300 rubles here. At the same time, a profit of 623,800 rubles was achieved throughout the association as a whole.

The output of tank trucks per ton of freight capacity must be increased to 457 tons or more for successful centralization of milk shipments. And this can be done only if small-capacity tanks are replaced with larger capacity tanks. Calculations show that if the previous tanks (3.4 tons) are used for milk transport planned in 1985, 2,600 tank trucks and more than 3,000 drivers will be needed.

And the use of tanks with capacity of 5.67 tons in centralized transport will reduce the number of truck trains to 1,235 and the number of drivers to 1,425. Fewer work hands will be needed, labor productivity will be higher and the most important thing, product quality will be improved.

The following characteristic--milk is a product shipped in lots--must also be taken into account in improvement of shipments. But the sovkhozes dispatch lots of milk in different quantities. They in turn depend on the daily milking volume on the same farm (the amount turned over by the farm on an average day within a single calendar month is taken as "lot of milk"). But all lots

increase gradually from January through June and, on the contrary, they decrease from July through December. For example, the Sovkhoz Rodina, Tselinograd Oblast, sells an average of 0.9-1.0 ton of milk per day in January and 5.3 tons per day in June, while the Sovkhoz 40 let Kazakhskoy SSR sells 8.2 tons and 20 tons of milk per day, respectively.

In other words, the nonuniform lot of milk rather frequently does not permit the use of large-capacity tank trucks for shipment since they will be underloaded. The way out is to use rolling stock of different freight capacity. this primarily improves the planning of shipments and the use of rolling stock. Milk carriers with increased capacity should be sent for lots of greater quantities of milk and correspondingly smaller tanks should be sent for lots of lower weight. But to do this, there must be a clear structure of the truck fleet in capacity and specailization of the vehicles according to the nature of shipments.

Centralized shipment of milk is also advantageous due to the fact that the single low-capacity tank trucks of the farms are being replaced by high-capacity milk carrier-truck trains. The output per "registered" truck-ton will also be increased due to improvement in organization of shipments.

The use of large-capacity tanks and truck trains will provide a significant saving of all production resources--finances, capital investments, human labor and materials.

One of the important problems in organization of centralized shipments is selection of the rolling stock and determination of the parametric series of milk carriers according to capacity, designed to operate with the highest productivity possible. This can be done on the basis of studying the characteristics of milk shipments and calculations of the economic indicators of individual tank trucks and milk carrier-truck trains under specific conditions. We performed this work on the basis of studying milk shipments from the farms of Tselinograd Oblast to the state milk procurement plants.

The series has eight standard dimensions arranged in the order of increase of freight capacity of the transport equipment (see Table 1).

Whereas 45 tank trucks with average capacity of 2.1 tons were used for shipment of 38,000 tons of milk prior to introduction of centralized transport, a total of 15 tank trucks with capacity of 4.9 tons would be required with centralized transport. Large-capacity tank trucks and truck trains also have higher output (for example, a unit of standard dimension 5 has 2,800 tons of capacity, while a unit of standard dimension 7 has 3,900 tons of capacity). The cost of shipments is reduced significantly and the economic effectiveness will increase (for example, a single ATsPT-11 replaces four ATsPT-2.1 tank trucks according to the number of tons transported. The saving from this replacement is 21,600 rubles annually).

It has become accepted to calculate the cost of shipments or operating expenses in kopecks per 10 ton-kilometers. If the operating expenses per ton-kilometer is multiplied by the transport distance, we find the operating expenses per ton

Table 1. Standard Dimensions of Rolling Stock and Results of Calculations of Economic Indicators of Their Operation During One Year at Average Transport Distance of 40 km

(1) № типоразмеров	(2) Марки автомоцистерн и автопоездов	(3) Грузоподъемность автомоцистерны или автопоезда	(4) Колич. един. подвижного состава	(5) Объем перевозок, тыс. т	(6) Себестоимость 10 т/км (коп.)	Экономич. эффективность использов. единицы подвижного состава (в тыс. руб). (7)
(8)						
1.	АЦПТ-2,1	2,1	2	2,4	152	—
2.	АЦПТ-2,1+0,9	3,0	1	1,5	147	1,6
3.	АЦПТ-3,3	3,3	2	3,6	125	3,8
4.	АЦПТ-3,3+1,1	4,4	3	6,8	112	5,7
5.	АЦПТ-3,3+2,8	6,1	2	5,6	92	10,8
6.	АЦПТ-6,2	6,2	2	5,1	77	10,7
7.	АЦПТ-6,2+3,3	9,5	1	3,9	65	20,3
8.	АЦПТ-11	11,0	2	9,1	70	21,6
	Итого (9)	4,9	15	38,0	93,4	—

Key:

1. Number of standard dimensions
2. Marks of tank trucks and truck trains
3. Freight capacity of tank truck or truck train
4. Number of units of rolling stock
5. Volume of shipments, thousand tons
6. Cost of 10 t/km (kopecks)
7. Economic effectiveness of using a unit of rolling stock (in thousand rubles)
8. ATsPT
9. Total

transported over this distance. As is known, operating expenses are accounted for by the motor transport enterprises themselves. But, besides these expenses, there are other expenses such as capital investments, expenses for loading-unloading operations and so on. Capital investments are required for acquisition of transport equipment, for construction of permanent facilities (garages and workshops) and structures for automated milk-filling and discharge systems. Like operating expenses, they can also be related to 1 ton of milk transported over a given distance (see Table 2).

It is obvious from Table 2 that transport expenses increase in proportion to the transport distance. For example, they comprise 8 rubles 65 kopecks per ton at a distance of 40 km and 17 rubles 92 kopecks per ton at a distance of 100 km for the ATsPT-2.1. Transport expenses are lower for larger capacity tank trucks and truck trains and significantly higher for trucks with small tanks. For example, they are equal to 8 rubles 65 kopecks per ton at a distance of 40 km for the ATsPT-2.1 and they are equal to 3 rubles 45 kopecks for the ATsPT-11.

It follows from the given examples that the motor transport enterprises that perform centralized shipments must select rolling stock according to the value of specific reduced expenditures.

Table 2. Variation of Operating Expenses, Capital Investments and Transport Expenses as Function of Transport Distance for Transport Equipment of Parametric Series

(1)	Расстояние перевозок (в км.)	Номера параметрического ряда подвижного состава (2)							
		1	2	3	4	5	6	7	8
(3) Грузоподъемность	—	2,1	3,0	3,3	4,4	6,1	6,2	9,5	11,0
(4) Эксплуатационные расходы, руб./т	40	6,50	5,89	5,0	4,88	3,7	3,1	2,6	2,36
	60	9,00	8,19	6,7	6,79	5,1	4,2	3,65	3,13
	100	13,0	12,8	10,2	10,6	8,0	6,4	5,7	4,65
Капитальные вложения (5) руб./т	40	2,15	1,71	1,53	1,12	1,1	1,4	0,9	1,1
	60	2,81	2,25	1,97	1,44	1,43	1,8	1,1	1,3
	100	4,12	3,31	2,84	2,13	2,0	2,57	1,6	1,86
(6) Транспортные издержки руб./т	40	8,65	7,6	6,53	6,0	4,8	4,5	3,5	3,45
	60	11,81	10,44	8,17	8,23	6,53	6,0	4,8	4,48
	100	17,92	16,11	13,04	12,75	10,0	8,97	7,3	6,5

Key:
1. Transport distance (in kilometers)
2. Numbers of parametric series of rolling stock
3. Freight capacity
4. Operating expenses, rubles/ton
5. Capital investments, rubles/ton
6. Transport expenses, rubles/ton

Besides miscellaneous expenses, transport expenses include thetotal cost of the produced product. Therefore, work to conserve operating expenses and capital investments per unit of transport operation (for shipment of 1 ton of product) must also be carried out. This can be specifically achieved by using higher capacity tank trucks and truck trains instead of low-capacity tank trucks.

Determination of the annual saving is substantiated in comparison of the transport expenses with respect to baseline and new equipment.

The ATsPT-2.1 tank truck is taken as the baseline equipment since it is usually employed by the farms prior to introduction of centralized transport (the saving per unit of rolling sotkc of the parametric series is presented in Table 1). The total saving comprises 132,800 rubles (3 rubles 49 kopecks per ton).

Fuel conservation when transport equipment of the proposed parametric series of milk carriers is used comprises 133 tons of fuel and lubricants when transporting 38,000 tons of milk and the number of drivers decreases one-half.

Of course, milk carriers, even large-capacity types, cannot in themselves produce good indicators if they do not have high operating reliability. And operating reliability requires creation of the corresponding conditions for

storage, maintenance and repair of the rolling stock. Hence arises the need for construction and reconstruction of the production and technical base of motor transport enterprises.

Those enterprises which are really engaged in organization of operation of trucks on the line will achieve good operating results. After all, not all truck trains can be fully loaded with milk on one farm; therefore, the movement of the truck train should be planned according to a "collection route," calling at 2-3 farms located on the route. The trailers for loading can be uncoupled on these farms beforehand and they can be coupled to the tractor on the return route and delivered to the state milk procurement plant. The density of the route (the distance between milk farmsteads) must be thoroughly studied and the condition of the roads and the approaches to the point of product output must be learned.

Centralized transport of milk is a progressive matter, but it requires careful restructuring. This is true of planning and management of transport problems, creation of complex driver brigades and the use of hourly traffic schedules calculated by using computers. All these measures will make it possible to increase product quality and to improve its delivery to the consumer.

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ARCHITECTS, BUILDERS FOR BAYKAL-AMUR RAILROAD

Moscow ARKHITEKTORY I STROITELI - BAMU (NOVYE V ZHIZNI, NAUKE, TEKHNIKE: SERIYA 'STROITEL'STVO I ARKHITEKTURA') in Russian No 7, Jul 82 (signed to press 21 Jun 82) pp 1-48

[Book "Architects and Builders for the Baykal-Amur Mainline Railroad", by architect Nariman Valentinovich Sukhanov and Igor' Sergeyevich Rozanov, meritorious builder of the RSFSR and honored transportation builder, Izdatel'stvo "Znaniye", 21,800 copies, 48 pages]

[Text] Annotation

The booklet is devoted to construction in the zone of the BAM [Baykal-Amur Mainline Railroad], which has been called upon to play an enormous role in development of the unique natural resources of the country's eastern regions and in development of their economy and culture. The booklet discusses the formation of the architectural face of the cities and settlements erected along the railroad, the advanced and efficient methods of construction and the inspired, creative labor of the designers and railroad builders. It is intended for designers, builders, instructors and students of architectural construction vuzes, technical schools and PTU [polytechnical universities] and for students of peoples universities.

Nariman Valentinovich Sukhanov, architect, has lived and worked for more than 20 years in the Arctic, in the Yakutsk ASSR. Being secretary of the Yakutsk Oblast Committee of the CPSU since 1974, he was head of the republic committee on construction of the BAM. As the chief architect of the BAM, he directly heads the work in development and implementation of the designs for construction of cities and settlements along the BAM.

Igor' Sergeyevich Rozanov, meritorious builder of the RSFSR and honored transportation builder, lives in Tynda, Amur Oblast He has been chief engineer of Glavtransproyekt [Main Administration of Planning and Surveying of the USSR State Industrial Committee for Transportation Construction], Mintrasstroy [Ministry of Transportation Construction] since 1970 and has been first deputy chief and chief engineer of Glavbamstroy [Main Administration for Construction of Baykal-Amur Railway Line] since 1974.

> The task is to open train traffic over the entire length of the Baykal-Amur Mainline Railroad and to organize work on economic development of the zone adjacent to the Baykal-Amur Mainline Railroad.[1]

The 26th CPSU Congress clearly and convincingly demonstrated the role and significance of the Baykal-Amur Mainline Railroad in the economic fate of the country's vast eastern region and in implementation of the party's economic strategy. In his Annual Report, General Secretary of the CPSU Central Committee, Chairman of the Presidium of the USSR Supreme Soviet, Comrade L. I. Brezhnev, in the summary documents of the Congress, devoted a great deal of attention to solution of the problems related to fundamental development of the natural resources and to an increase of the economic potential of the country's eastern and northern regions.

"The Sayan, Bratsk-Ust-Ilim and Southern Yakut territorial industrial complexes, noted L. I. Brezhnev, "play an increasing role in the economy of the country's Asiatic section. The Baykal-Amur Mainline Railroad will open up great opportunities for expansion to the east and to the north."[2]

And this is really so. The BAM, as the most important artery of the production infrastructure in the country's eastern part, will create a qualitatively new economic situation that will permit more active exploitation of the richest natural resources in the national economic circulation of the state and more intensive development of the productive forces of this region.

It is natural that the timber resources and the richest minerals, located directly along the BAM route, will be developed first, but the advance to more remote sections of the route, related to development of the oil and gas fields, coal fields, iron ore deposits and nonferrous and various tyeps of rare metal deposits, and consequently to development of new cities and settlements, will then begin. Therefore, it is no accident that the Basic directions for economic and social development of the USSR for 1981-1985 and for the period up to 1990 posed the task of working out the technical and economic substantiation for construction of a railroad from Berkakit station to Tommot and Yakutsk. One can assume that similar railroad meridians will also be laid from other points of the mainline to the other northern storehouses of this region.

It is also no less important that it will be considerably easier to eliminate the lag of remote and sparsely inhabited regions in the economic and cultural fields and to raise the standard of living of their population, specifically, of minor nationalities of the country's northeast, from the "BAM trampoline." This fully corresponds to the aim of the 26th CPSU Congress to equalize the social differences in the territorial layout. Analyzing this problem, Comrade L. I. Brezhnev emphasized:

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[1] "Materialy XXVI s"yezda KPSS" [Materials of the 26th CPSU Congress], Moscow, Politizdat, 1981, pp 171, 188.

[2] Loc cit., p 33.

"It is these differences that have frequently complicated the situation with labor resources in some locations. Implementation of the programs for development of Western Siberia, the BAM zone and other sections in the Asiatic part of the USSR increased the influx of the population to this area. And even so people until now frequently prefer to travel from north to south and from east to west, although the efficient disposition of the productive forces requires movement in the opposite directions."

"A person leaves, let us say, Siberia most frequently not because he cannot tolerate the climate or because of low wages but because it is more difficult to obtain housing there, to enroll a child in kindergarten and because of few cultural centers. That is why we plan during the current five-year plan to construct housing and an entire sociocultural complex in these regions at even higher rates. The situation here must be changed and within a short time."[1]

It follows from this that construction of the BAM and economic development of the adjacent territories are related to implementation of the grandiose program in town building, directed toward development of the most favorable conditions for work, services and recreation of the Soviet people living in remote regions with severe climate and toward strengthening of the cadres in these regions.

An important role is being allocated to BAM in development of the international economic ties of the USSR as well. The railroad will create a new direction for exported goods and also for transcontinental shipments between Europe and Eastern Asia and will stimulate development of the country's system of Pacific Ocean ports and the related large complexes of the refining industry.

The general goal for economic development of the BAM zone is creation of a new industrially developed zone in Eastern Siberia and in the Far East that will guarantee phased complex development of the productive forces of the northern regions of this area and accelerated development of their richest natural resources, and on this basis, an intensive increase of the country's economic potential.

Implementation of this main goal will depend to a considerable degree on the rates of economic development of the BAM zone, on the effectiveness of capital investments directed toward development of it and also on successful solution of the problems in capital construction and town building. The need "to achieve the maximum return from the largest investments within the shortest deadlines which the state has directed toward construction of the mainline railroad"[2] is noted especially in the materials of the 26th CPSU Congress.

In 1974, the decree of the CPSU Central Committee and the USSR Council of Ministers "On construction of the Baykal-Amur Mainline Railroad" was adopted.

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[1] "Materialy XXVI s"yezda KPSS", Moscow, Politizdat, 1981 p 54.

[2] Loc. cit., p 121.

During the years that have passed since then, the collectives of Mintransstroy and the chief construction organizations of all the union republics have completed very important work in construction of railroad track and erection of populated points located along the mainline. A total of 294 million m^3 of excavation work has been carried out as a whole, more than 2,100 km of highways along the track, more than 700 bridges have been constructed and 1,100 water pipes have been laid. The total length of main track laid by the beginning of 1982 was 2,250 km, including 490 km from Lena station to the east, 680 km from Tynda to the east and to the west and 710 km from Komsomolsk-na-Amur to the west. Operating train traffic has been established on all these sections, as on the "minor BAM" line, passing from Bam station through Tynda to Berkakit (379 km).

The party, Soviet, trade-union and Komsomol organizations of Irkutsk, Amur and Chita Oblasts, Khabarovsk Kray and the Buryat and Yakutsk ASSR are conducting enormous organizational work to mobilize the labor collectives to fulfill the plans and socialist pledges on construction of the BAM and to turn over individual sections of the BAM for permanent operation ahead of schedule.

Construction of the railroad of the century has met with a warm response throughout the entire country. Many union republics, krays, oblasts and autonomous republics of the RSFSR have adopted patrons' pledges to participate in planning and construction of housing and civil facilities in the cities and settlements near BAM stations.

The BAM is an All-Union Komsomol shock construction project. It has become the distinguishing labor and life school for many thousands of our young men and girls. Their main slogan "We are constructing BAM--BAM is forming us" has been convincingly confirmed by practice.

The idea of constructing a high-latitude mainline railroad above Lake Baykal occurred during the early part of this century, when the eastern part of the Transsiberian Mainline Railroad was being constructed. However, this thought began to take on living reality only during Soviet power, when the principle concept of developing the country's eastern regions began to be compiled at the end of the 1920s on the basis of studying Siberia's natural resources. The first proposals for routing the railroad track adjacent to the northern boundaries of Lake Baykal were formulated and the first surveys were begun during the early 1930s, while the future railroad was named the Baykal-Amur Mainline Railroad.

The beginning of construction of the BAM can be dated to 1932. Construction of the mainline was entrusted to a special organization, which had completed construction of the connecting BAM-Tynda and Izvestkovaya-Urgal branches by 1941, and the rail track moved from Tynda to the north.

World War II interfered with full realization of the thought-out plans. In 1942, the rails of the BAM-Tynda railroad branch were dismantled with regard to construction of the Svyazhsk-Stalingrad Railroad and were used to lay a front lateral railroad near Stalingrad. After the war, the tasks for the

national economic development of the country's northeast forced us to again return to the question of construction of the BAM. Two large sections of the Tayshet-Bratsk--Ust-Kut and Komsomolsk-na-Amur--Sovetskaya Gavan Railroads were first constructed, which subsequently made development of the basic mainline considerably easier. The Izvestkovyy-Chegdomyn Railroad was constructed with regard to development of the Bureya coal basin, while the railroad from Khabarovsk to it was constructed for development of Komsomolsk-na-Amur, which also had a positive effect on construction of the BAM. The country will receive a new transport artery from Tayshet to the Pacific Ocean after completion of the construction project. Implementation of this grandiose idea, which has a long history, became possible during developed socialism on the basis of the increased scientific and technical potential of our government and of its economic might.

To fulfill the functions of the customer, the USSR Ministry of Railways has organized a special Board of Directors for construction of the BAM. The design and construction of mainline facilities was entrusted to the USSR Ministry of Transport Construction. A special service of the chief architect of BAM, who was entrusted with coordinating the activity of all the planning institutes that support working out of the general plans, planning drafts and construction of the cities and settlements on the mainline, designs of the station buildings, apartment buildings and other civil facilities, of following the correct solution of architectural-planning and engineering-technical problems with regard to the specific features of different natural climatic regions through which the BAM passes, was created in RSFSR Gosstroy. A Group for operational monitoring of BAM of the RSFSR Gosstroy, located at Tynda, was created especially to monitor the complex construction project and the quality of the housing and civil construction.

For one to imagine the range and complexity of the problems being solved on the BAM, one must become thoroughly familiar with the climate and engineering and geological conditions of this route.

The BAM route begins on the Lena-Angara plateau in the Prebaykal depression. It passes in the western and eastern sections mainly through mountain locations with grades of more than 20° and with absolute altitude marks up to 1,500-2,000 meters above sea level and above. Here it intersects the slopes of a number of large chains such as the Baykal, Northern Muy, Muyakan, Udokan, Bureya and so on. Low- and medium-altitude relief is typical for the central section of the route. Here it passes through the morain areas of the Verkhne-Zeya, Amur-Zeya and Zeya-Bureya valleys. The BAM route intersects more than 3,000 streams, including the Lena, Amur, Zeya, Vitim, Nyukzha, Chara, Amgun and other large rivers. Most of the rivers are mountainous in nature (rapid current), pass through deep gorges and have abundant rapids and shoals. The rivers usually freeze over completely in winter and layers of ice form on them.

The climate of the greater part of the BAM route is continental, moderately cold and comparatively stable.

The characteristic feature of the climate of the entire route is a negative mean annual temperature balance: from -0.5 to -11.4°C. The temperature drops to -61°C (Berkakit) in some locations in January, while the temperature rises to +40°C (Fedkin Klyuch, Alonka and Urgal) in June. The average January temperature reaches -36° (Berkakit) and the average July temperature reaches +20°C (Komsomolsk-na-Amur). The annual amplitudes of average monthly tempeta-ture fluctuations on the BAM range from 30 to 50°C. The average annual pre-cipitation ranges from 300 to 500 mm (it reaches 700 mm in some sections). The average wind speeds in January are insignificant over the entire route and mainly do not exceed 2 m/s. The only exception is the Tynda region, where the wind speed reaches 3.6 m/s.

In the geological sense, the BAM route consists mainly of a complex of crystal-line rock of different age with outcrops of sedimentary rock on individual sec-tions. The mainline passes through a zone of permafrost soils over a signif-icant length, near the southern boundary. The thickness of the permafrost differs on different sections of the route: it does not exceed 50 meters in the western and eastern sections and it reaches 250 meters or more in the cen-tral section. Permafrost soils are considerably different in temperature on different sections of the route. Thawed sections are frequently encountered along the beds of large rivers. We note that the permafrost frequently serves as a waterproof barrier to swamps and mari, which cover the route over a sig-nificant length.

Many sections of the mainline pass through seismically dangerous territories. The seismic-tectonic manifestations in this region have not been adequately studied, but they must be taken into account in all cases. The route passes through regions with seismic activity of 9 in Irkutsk an Chita Oblasts and in the Buryat ASSR and it is even higher in some sections.

But the most distinguishing feature of the BAM route is that it is character-ized over a length of more than 1,000 km by permafrost soils and seismic activity simultaneously. Need one explain how complicated these conditions are for construction?

The severe climate, complex relief, severe and diverse geological conditions and finally seismic activity have a different effect in different regions of construction in the BAM zone and dictate the need to approach each zone individually.

Planning

Filled with high patriotism, the slogan "The entire country is building the BAM" is related not only to the builders, railroad workers and suppliers of production equipment and construction materials. Realization of this slogan began with the planning solutions, with working out the basic town-building concepts for development of the BAM zone and with the idea of planning and construction of each populated point of the railroad. And the most impor-tant role here belongs to the architects. Working out the town-building documents for the long term, they were the first to thoroughly study and learn all the variety of objective and subjective conditions of the region and

determined the basic methods of developing the cities and settlements of the future large national economic complexes.

The town builders, economists and sociologists, on the basis of a complex approach to the use of mineral and raw material, timber, water and other resources of the zone, worked out proposals for efficient organization of the system of settlement and intrasettlement cultural and everyday services, development of a network of urban and rural populated points, disposition of recreation zones and so on. This author's collective is now working on publication of a "Complex scheme for environmental protection in the BAM zone." The LenNIIPgradostroitel'stvo Institute [not further identified], with the participation of LenZNIIEP [not further identified] and TsNIIS [All-Union Scientific Research Institute of Transportation Construction], Mintransstroy, later worked out the "Recommendations on planning of populated points of the BAM," which were used extensively in working out specific designs.

The planning institutes of Mintransstory: Mosgiprotrans [Moscow State Planning and Surveying Institute of the State Industrial Committee for Transportation Construction, USSR], Leningiprotrans [Leningrad State Planning and Surveying Institute of the State Industrial Committee forTranspor tation Construction, USSR], Tomgiprotrans, Sibgiprotrans and Dalgipro trans, were appointed general contractors for individual sections of the BAM. According to their assignments, the planners of all the patronage republics, krays and oblasts and also of Moscow and Leningrad worked out the general plans of the towns and settlements, the designs of individual housing and civil facilities and municipal and service facilities. The republic organizations of the USSR Union of Architects participated actively in working out the design and planning documentation.

The workers of the chief architect's service of BAM are frequently assigned the following problems: how do you imagine the unified architectural grouping of the mainline extending for 3,200 km? Can this problem generally be solved? In such cases one would have to answer that a unified grouping does not mean the same, i.e., created by a unified model and pattern, and that the architectural unity of such an extended complex as the BAM is seen primarily in the variety of town-building procedures, in contrast to the multinational architectural solutions found by the architects of all the union republics, in the richness of this variety. The subjective conditions typical for the BAM zone and also the subjective factors of its economic development unconditionally contribute to this, which also finds specific reflection in the design and planning documentation. RSFSR Gosstroy has constantly oriented the planners toward compulsory consideration of the regional characteristics of the route--such as the undeveloped nature of the territories, their remoteness from industrial and cultural centers and the complexity and variety of severe natural and climatic conditions, different combinations of which frequently advance contradictory requirements on planning and construction of populated points. Gosgrazhdanstroy [not further identified] and RSFSR Gosstroy worked out unified requirements on the architectural and planning organization of populated points on the BAM from the very beginning of the search for a town-building concept. The main ones of them are:

maximum compactness and density of the construction site;

clearness of architectural and planning construction and clarity of composition, based on the fact that the main axes should become the streets leading to the railroad station, the production zone and the social center.

It was recommended that all types of services cooperate to the maximum extent in the unified social and commercial center and that it be located in the center of the settlement--on the main traffic routes to the production zone and to the station.

It must be especially noted that the location of the housing settlements when working out the preliminary design of the BAM was determined on the basis of the norms for deployment of the operating subdivisions of the railroads, i.e., at railroad stations located an average of 40-60 km from each other. But since the potential capability of further development due to exploitation of nearby natural resources was embedded in the design of each populated point of the BAM, the task of providing reserve territories in the general plans of the settlements for all functional zones--production, housing, municipal and so on--was posed as the most important condition of design.

If each BAM settlement is considered as a unified town-building grouping, then its main element should undoubtedly be regarded as the building of the railroad station. Traditional forms and features of the national architectural and artistic schools of the union republics participating in construction of the BAM found their fullest expression in the architecture of the stations.

It was recommended that a specific percentage of garden type construction--single-story buildings with sections for raising fruit and gardening--be provided in the designs for planning and construction of the settlements in individual regions of the BAM zone having relatively favorable natural and climatic conditions. It was recommended that for those living in two- to five-story buildings that collective sections be created beyond the housing construction for a private auxiliary farm (calculated at 300-600 m^2 per family).

Special attention was devoted to the designs of the engineering equipment of populated points--to measures to prevent the water freezing in the water supply installations and in water lines, to the use of small purification plants, refuse incinerators and so on.

All these requirements and recommendations were reflected to one or another degree both in the designs, in the practice of construction and in operation of the towns and settlements of the BAM. However, not one of them is similar to the other and each has its own unique feature. This is achieved not only as a result of the differences in the nature of the relief or of the surrounding natural landscape, but also due to the unique facade of the erected facilities, the contrast of high one-section homes with extended block-sectional buildings and the low volumes of public buildings. Supporting walls and banks are used in places with steep relief. Color, small architectural shapes and the elements of good organization are employed extensively to enrich the composition.

One can now conclude that, during the first phase of development of the BAM zone, the patronage method of constructing its populated points fully justified itself. Let us consider a number of towns and settlements of BAM as confirmation of this.

Tynda. This town is frequently called the capital of the BAM and primarily due to the fact that it has an advantageous geographic position. Its predecessor--Tyndinskiy Settlement--was born during the first years of Soviet power as one of the support points of the Amur-Yakut major highway being developed at that time, which links many regions of the Yakut ASSR to the Transsiberian Mainline Railroad. Its population comprised no more than 5,000 persons in the early 1970s. The route of the "small BAM" essentially passed alongside the Amur-Yakut Mainline Highway and it intersected the route of the main BAM at Tynda, which also determined the location of the main headquarters of the construction project here. By the end of 1981 the population of workers and specialists of Glavbamstroy, contracting and patronage organizations of Tynda, comprised almost 20,000 persons. The Administration of the Baykal-Amur Railroad and all its services, which number approximately 5,000 workers, are based in the town. The town is being transformed into the largest transport terminal in the country's east. Its population has already exceeded 50,000 persons, which considerably surpasses the planned calculations.

The general plan of Tynda was developed by Lengiprogor Institute [Leningrad Branch of the State Institute for the Planning of Cities]. Architects of Mosproyekt-1 implemented the design for detailed layout of the central part of the city, which Moscow builders are constructing.

The main settlement territories of the city are located near the foot and on the southern slope of a large, taiga-covered sopka, the upper part of which serves as a natural park. The Getkan River flows below the southern boundary of the construction site and beyond it passes the main route of the railroad. Thus, the suite of terrace-arranged city quarters on a background of a green tract and pure blue sky presents an excellent view. The city is being transformed literally before one's eyes and is acquiring the face of the capital. Its central part is being built with snow-white nine-story buildings, the structures and parts of which were manufactured in Moscow, but with regard to the natural climatic conditions of Tynda: the outside panels have been significantly insulated and the carpentry products for the windows and doors were made with triple glazing.

The main street of the city--Prospekt Krasnaya Presnya--is being completed from both directions with squares. A unique social and cultural center is being built on the western square. Its architectural grouping includes the House of Soviets with tribunal for meetings and a memorial to V. I. Lenin and sports and commercial complexes. The building of Glavbamstroy, interesting in its architecture, will occupy the southern side of the square and a wide screen movie theater is already under construction. The multistory building of the Administration of the Baykal-Amur Railroad, which will also overlook the main street of the city, will grow on the eastern triangular area. It is planned to construct four 16-story apartment buildings, joined

at the level of the first floors by cultural and service institutions--an exhibition hall, book store with movie room, transportation and expeditionary department, department for communicating with long-distance telephone exchange, the Molodezhnoye Cafe and so on--will be constructed along Prospekt Krasnaya Presnya. The building of the railroad station should become very original both in architectural composition and in functional solution. Its design has been noted at the international competition in Sofia (the architects are V. Gudkov and A. Kozlov).

Tynda also has its own town-building problems. Unfortunately, the data on the groundwater reserves capable of fully meeting the needs of the population for water in the future were not confirmed. Therefore, the main source of the water supply should become surface sources, i.e., a rather large reservoir must be designed and constructed on one of the rivers. The general municipal heat supply and sewer system is being slowly expanded. And finally, the city cannot be constructed only of imported structures--the problem of constructing their own house-building combine must still be resolved.

Neryungri. The name of this city, translated from the Even language means "Grayling's River." And the city is actually located near this river, on a picturesque taiga hill. At the present time this is the final destination of the railroad track of the "small BAM." And whereas Tynda is called the capital of the BAM, Neryungri has been justifiably named the capital of the southern Yakutsk coal complex--the first large industrial junction on the BAM that has begun to provide a real return of the funds invested in the mainline. In 1981, more than two million tons of high-quality coal was shipped to the country from the Neryungri coal mine.

The architects and engineers of the Yakutgrazhdanproyekt [not further identified] were faced with much labor and primarily the general town plan developed by them was confirmed. And it was really difficult to find a good solution. A severe winter, permafrost and seismic activity are present at Neryungri. The soils everywhere are underlain by coal seams, on which buildings cannot be placed--it must first be removed from under the foundation and the footing must be concreted. Solution of the main problem--for what population should the town be designed--brought many concerns to the town builders. After all, Neryungri is not only a coal mining town, but it should in time become the center of the entire southern Yakutsk territorial industrial complex, which includes the newly created enterprises of ferrous and nonferrous metallurgy and a number of other sectors of the national economy. The population of the city will be 70,000 persons for the first unit of construction up to 1990, while it will number 100,000 with a future reserve up to 300,000 persons by 2000.

During the first phase of development of Neryungri, when its own precast house-building base had only been created, housing and civil construction were carried out mainly of wooden structures. Therefore, the architects had to solve the complex problem of harmonious town-building linkage of the first wooden quarters to the main multistory microrayons, which also determined the architectural and planning structure of the city. The basis of its composition

was a system of mutually perpendicular layout axes. The main route from the eastern regions of the wooden construction project passes through the center of the city and terminates in the west with a cultural and recreation park and sports complex. The north-south axis also passes through the center of the city, where the general municipal social center with main square is being formed. The House of Soviets, Palace of Culture, the administrative building of the Yakutugol' Association and other large cultural and service facilities are located on it. Special attention was devoted to the architecture of the western and northern "facades" of the construction project, which are easily seen both from the railroad and from the highway route, in the design of the detailed layout of the central part of the city, developed by the Giprogor [State Institute for the Planning of Cities] and Yakutgrazhdanproyekt Institutes.

The Neryungri Large-Panel House-Building Plant, which assimilated production of multistory apartment buildings of series No. 122, developed by LenZNIIEP Institute especially for the BAM zone, began production in 1980. The wall panels of these buildings are multilayer using highly efficient insulation, as a result of which the walls of the buildings remain dry and warm even during the most severe cold. The residents given high marks to their apartments. Preparation is now under way for construction of apartment buildings for new versions of this series--with attached balconies having removal glazing. They not only guarantee additional conveniences to people, but also help to create a unique architectural rhythm that contributes to the variety of construction of the city.

We would especially like to dwell on the fact that Neryungri is the first populated point of the BAM where the plant of the unified decorative monument formulation of the towns and settlements of the mainline will be implemented. It includes construction of sculptured memorials devoted to the founders of Siberian resources, to the young builders of the BAM and so on. Famous architects and sculptures, members of the USSR Academy of Arts, whose activity is being coordinated by the Peoples Architect of the USSR, Academician M. V. Posokhin, are being recruited to complete these works.

Severobaykalsk. The name of this town itself indicates its location. The natural and climatic and economic conditions of its development and also the overal town-building situation permit one to assume that Severobaykalsk will become a real pearl in the constellation of BAM cities. The taiga landscape and the amazing beautiful panorama, which faces the blue window of Lake Baykal and the snow-covered peaks of the mountains surrounding it, are being successfully combined on the site selected for the city. The river tributaries leading to the lake surround the excellent forest and park zone--a recreation area for the citizens, created by nature itself.

Architects of Lengiprogor Institute have studied all these valuable natural factors and have reflected them in the general city plan, in the layout designs and the construction site of its microrayons, streets and squares. Specifically, to protect small quarters against the severe winds and snowstorms, multisection "snake-like" five-story apartment buildings have been designed. This configuration of the buildings and the well-selected colors

of the enclosing panels have been successfully enscribed into the surrounding environment and create a happy mood. The main thoroughfare of the city is laid perpendicular to Lake Baykal and picturesque descents into the forest park and to the beaches lead from it. On the other side, the main thoroughfare emerges to the central square, the architectural face of which is formed by public buildings.

The future railroad state of Severobaykalsk is very interesting in architecture--its silhouette, by intention of the Sibgiprotrans architects, reminds one of an oncoming Baykal wave. A curved reinforced concrete monolithic shell is used as the roof.

Construction of the city has been entrusted to Glavleningradstroy [Main Administration for the Housing, Civil Engineering and Industrial Construction of the Leningrad Gorispolkom]. Prefabricated building structures are being manufactured at its enterprises in Leningrad from designs of LenZNIIEP. They will then be delivered to the construction sites of Severobaykalsk, where these structures will be assembled. The combination of high-temperature permafrost soils and high seismic activity presents special construction difficulties in Severobaykalsk. The Leningrad planners and builders have resorted to the so-called method of gradually cutoff connections of the metal frame of the foundation supports in their foundation designs, which guarantees high reliability and stability of the buildings and structures during seismic activity of different intensity.

However, the city has its difficulties and its problems of development. Specifically, construction of the general municipal boiler plant is being drawn out, which delays putting the permanent water supply and purification plants into operation and interferes with rhythmic introduction of apartment buildings and cultural and service buildings.

Niya. This settlement is rightfully considered one of the best on the BAM. Successfully enscribed into a rather complex relief, the village has achieved a unique architectural and artistic face and aspect. And this is not accidental. The architects and engineers of the Georgian SSR, who know how to build on complex relief, are developing Niya. Finishing materials (granite, marble and so on) and also Georgian folk motifs, embodied in the architectural and artistic solution of the buildings delivered from Georgia, provide great variety.

The settlement is designed for 1,500 residents. The square, construction of which is formed by the school buildings, kindergarten and public-trade center (the latter contains and movie and concert hall, snackbar-cafe, library, post office, savings bank and so on), is its composite nucleus. This concentration of public and service spaces in a unified complex conserves the time of workers and creates additional conveniences for them. Let us recall again that the severe natural and climatic conditions of the BAM zone force one to construct any populated point of it as compactly as possible.

The properties of the surrounding landscape are well utilized in the design. The steep relief of the section determined the placing of five-story brick

buildings on the artificially created terraces. The relationship of the central square to the upper and lower terraces by using retaining walls, slopes and stairs imparts a unique and characteristic face to the settlement. The features of Georgian architecture are also reflected in the small architectural shapes and in the development elements. All the facilities of Niya reflect the high quality of construction and installation and finishing work. The village as a whole gives one the impression of monumental value and completeness and indicates the exceptionally natural approach of the Georgian masters of architecture and construction affairs to fulfillment of their patronage pledges in construction of the BAM.

It should be noted that this extensive work in design and construction of populated points, of the Irkutsk section of the BAM, put into operation, was carried out by the patronage organizations of the Armenian and Azerbaijan ASSR, the Chechen-Ingush, Severo-Asyatinsk and Dagastan ASSR, Krasnodar and Stavropol Krays and Rostov Oblast.

Urgal. This village is one of the main ones in the eastern section of the BAM. It is called the younger brother of the Donbass for two reasons: first, it will be the center of a new coal basin and second, Ukrainian designers and builders are developing it, including a large Komsomol detachment from Donetsk Oblast. As a municipal type settlement, it was designed around the Urgal Railroad Station, at the point where the BAM connects to the existing Izvestkovaya-Chegdomin Railroad branch. This arrangement of the village determined the town-forming base of its development for the near future and also its significance in the system of populated points of the BAM.

The settlement is located on the left bank of the Urgal River (the Amur River basin) within the western limb of the Bureya depression and encompasses a high terrace above the floodplain and a plateau. The uncluttered site and the picturesque orientation of the slopes created great opportunities for using the most diverse composite procedures of construction.

The housing settlement with total population of 11,000 persons is designed as a unified functional and planning structure, formed of four housing groups that enclose the center. Further growth of the settlement is planned in the eastern direction. A hospital complex is located on the west. An important feature of the town-building decision is the clear architectural definition of the functional spaces: square, commercial street and housing streets. The housing groups are very compact and their dimensions were determined by the amount of living area serviced by a single children's institution. Conditions have been created in each of the groups for a complex living environment and the unity of the apartment, building, the territory in front of the building and public and municipal services has been realized.

The scheme for servicing the settlement is two-step--with classification of service facilities by frequency of demand. This guarantees total functioning of the settlement as housing groups are erected and determines the concentration and specialization of service institutions. The principle of compactness is also the main means of developing the living environment here. It contributes to regulation of the microclimate and to reduction of the time a person

spends outside under unfavorable weather conditions. The social and commercial center combines different blocks by designation: trade, House of Communications and House of Services, and its universal space considerably enriches the face of the street. A universal space--a winter garden and recreation area, to which the site is visually connected to the landscape--has also been created in the cultural viewing center.

The housing regions are being constructed of large-panel apartment buildings of series 94-BAM, which take into account the severe local natural climatic conditions, and also of brick buildings, in finishing of which Ukrainian national ornamentation will be used extensively. Folk motifs can also be seen in the colorful solution of the stained-glass panels.

The design provides for a high degree of development of the settlement due to creation of a clearly differentiated system of transport communications and recreation zones--streets for transport, boulevards, pedestrian walkways, recreation sites, adult and children's playing fields, green territories, natural green plantations, regular lawns, flower beds and so on.

Soloni. The location for construction of this settlement is located 53 km from Urgal, on a steep slope covered with a thin coniferous forest. Architects and builders of the Tadzhik SSR are participating in development of it. The designers were faced with a complex town-building problem: to create a compact and comfortable housing settlement on a very crowded site with steep drops and to provide in it all the types of services to the population, a complete complex for development and good transportation communications of the settlement and station and service and technical buildings of the railroad station, located a significant distance from the housing quarters. And the Tadzhik designers coped successfully with this task.

The center of the settlement, which includes the buildings of the public and commercial center, schools, a kindergarten and polyclinics, are beautifully arranged on the highest point of the construction site. The steep drop of the relief markers was used to create a unique esplanade, which also emphasizes the dominant position of the center, and connects it to the housing construction sites. All cultural and service facilities for the population are located within walking distance, which is very convenient to the population under the severe natural and climatic conditions. The smart two-story two-section apartment buildings with all conveniences will be populated in apartments by the families of railroad workers. The national solar color of Tadzhikistan is present in the formulation of the building facades and of the children's play areas and in the small architectural forms.

The interesting station building has been connected to the bus station. Built on the complex relief of the station section, it abuts the bank almost tightly on one hand, while it is turned toward the settlement on the other end, where the waiting room is located. The lighted stained-glass panels of the station create a very attractive picture at nighttime. As a whole, the architecture of the station is tectonic, modern and brings joy to the eye with its beautiful Tadzhik ornamentation. Those arriving at Soloni immediately feel that this settlement was designed and constructed by representatives of a sunny kray in the severe Far Eastern taiga.

Alonka. The Moldavian stork with purple bunch of grapes in its claw is found in both the facades and in the interiors of the public and apartment buildings constructed in the settlement by representatives of the Moldavian SSR. Alonka belongs to the small populated points of the BAM--approximately 1,500 persons will live in it, which also determined its architectural and layout structure. The settlement is located on an inclined southeastern slope, covered with forest, and consists of two groups of brick apartment buildings of 2-5 stories and a public and commercial center, kindergarten and medic-obstetric station located between them, which made it possible to create convenient and short communications between the housing area and service facilities. A memorial to Sergey Lazo, Hero of the Civil War, constructed from funds paid by Moldavian students during their labor semester, has been installed on the small central area in front of the school building. We would like to note that all the housing and civil facilities and developments have been completed with high quality.

The relatively mild climate of the region in which Alonka is located permits its residents to be actively involved in auxiliary agriculture. Therefore, economic and service sites for domestic cattle, poultry and feed storage are being constructed with each group of apartment buildings and sections are also being allocated for private gardens.

All the other union republics of our country are also making an enormous contribution to formation of the enormous international architectural "grouping" of towns and settlements of the BAM. Thus, the designs of the settlements developed in the Kazakh SSR (Chara Settlement), the Uzbek SSR (Kuando Settlement), the Belorussian SSR (Muyakan Settlement), the Lithuanian SSR (Uoyan Settlement), the Estonian SSR (Kicher Settlement) and the Latvian SSR (Taksimo Settlement), are very interesting in town-building solution and in the architecture of the housing and public buildings and specifically, of the stations. Representatives of the Altay and Krasnoyarsk Krays, the Bashkir and Buryat ASSR and the Moscow, Novosibirsk, Chelyabinsk, Perm, Sverdlovsk, Tula, Saratov, Volgograd, Penza and other oblasts of the RSFSR are carrying out extensive work in layout and construction of the towns and settlements of the BAM, along with Moscow and Leningrad workers. The recently created Union of Architects of the RSFSR has been actively included in the work in the BAM.

The most important goal of the main architect's service of the BAM remains the task of skillfully combining the multinational color and rich experience of the construction arts of all the fraternal republics and of all nationalities of our great Motherland.

Construction

We have already said that all the main work in construction of the BAM has been entrusted to Glavbamstroy, created in 1974 as part of the USSR Ministry of Transport Construction. Its duties include construction of the BAM from Ust-Kut to Tynda (1,625 km), the Bam-Tynda-Berkakit lines with branch to the Neryungri coal mine (430 km), double tracking of the Tayshet-Lena railroad line (733 km), the construction industry bases at Tayshet and Shimanovsk and a number of other facilities.

The All-Union Leninist Komsomol took on itself formation of construction subdivisions by qualified working personnel--the construction project properly bears the name of All-Union shock komsomol project. The volunteer detachments imeni 17th and 18th Komsomol Congresses, the 26th Party Congress, the Moscow Komsomolets, Belorussian Komsomolets, Volga Area Komsomolets, Korchaginets and other detachments became the basis for many BAM collectives. The youth on the BAM comprises more than half the workers and the experience of the senior comrades helps the youth to achieve remarkable labor successes. Very important patriotic calls such as the following are developing among the young builders: "I am the manager of the constructio project," "On confident technology until the end of BAM construction" and so on. Moreover, the organizations of Glavbamstroy annually take on up to 5,000 troops of the student construction detachments, which complete construction and installation work worth no less than 10 million rubles during the summer work semester.

Glavbamstroy now includes six contracting trusts and construction administrations (Angarskstroy, Nizhneangarskstroy, Lenabamstroy, Bamstroyput', Tsentrobamstroy and Tyndatransstroy), which perform general construction work and lay the track superstructure, specialized trusts for excavation, drilling-explosive and sanitary engineering-electrical installation work (Bamstroymekhanizatsiya, Zapbamstroymekhanizatsiya, Bamtransvzryvprom and Bamtranstekhmontazh), a trust for organization and supply of construction with structures and materials (Bamstroykomplekt), a special design and technological office that carries out planning-design and technological developments, and also scientific research of an applied nature related to organizatin of BAM construction. All these organizations, besides the Angarskstroy and Bamstroyput' Construction Administrations, were newly created during 1974-1975. Moreover, specialized construction organizations of the other main administrations of Mintransstroy: Mostostroy Trust No. 9 and Mostostroy Trust No. 10 of Glavmosstroy, the Bamtonnel'stroy Construction Administration of Glavtonnel'metrostroy, and also subdivisions to carry out heavy current electrical installation work, to install communications and to assemble the boiler equipment of Glavtranselektromontazh are participating in construction of the BAM. More than 30 patronage construction organizations of all the union republics and also the construction subdivisions of Minmontazhspetsstroy SSSR [USSR Ministry of Construction and Special Installation Work], Minenergo SSSR [USSR Ministry of Power and Electrification] and others are acting as contracting subdivisions of Mintransstroy on the BAM.

The BAM is an exceptionally material-consuming construction project and its orders are fulfilled by thousands of enterprises and organizations. The geography of deliveries is from the Ukraine to the maritime kray and from the Baltic area to Kirghizia. Excavators arrive at the BAM from Voronezh and Donetsk, tractors arrive from Leningrad and Chelyabinsk, drilling rigs come from Cherkassy Oblast, trucks come from Minsk, rolled metal comes from Novokuznetsk and Magnitogorsk and cement comes from Krasnodar Kray. The collectives of industrial enterprises relate to the orders of the construction pro ject as to honorary assignments and they try to complete them ahead of schedule and with high quality. The ties of BAM builders with the country's organizations and enterprises are becoming ever closer and cooperation has been organized by mutual agreements. Thus, the Tyndastroy Trust cooperates effectively

with the Novokuznetsk Metallurgical Combine, the Tayshet and Ushumun Tie-Impregnation Plants, the Tselinograd, Mochishche and Darnitsy Reinforced Concrete Structures Plants, the Lengiprotrans Institute and so on. Cooperation is implemented on the principle of the "workers' relay race" and has fully justified itself.

The BAM has no equal in the worlwide pra ctice of railroad construction by the volume of construction and installation work, the engineering complexity and diversity of engineering structures, by the compressed construction deadlines and by use of modern machines and mechanisms. The construction project required a special approach and development of technology, equipment and structures and the collectives of the country's enterprises and organizations responded immediately to its requests. Thus, the Perm and Khora woodworking combines designed and are producing structures of prefabricated wooden houses for the BAM builders. The Leningrad workers have developed and are delivering BAM-500 mobile electric power plants to the construction project. Drilling, hoisting and road equipment for working under especially complex conditions at low temperatures is being designed and produced.

The BAM builders feel a daily spiritual tie to the country. A system of television stations has been created in the railroad zone and all its settlements receive Central television transmissions. Tens of artistic collectives and hundreds of master artists have visited here with patronage concerts and creative accounts during construction. "Railroad lights" festivals, Pushkin days on the BAM and others have become traditional. Writers, poets, artists and composers address the BAM topic, creating a heroic manuscript of the BAM. The ties of the BAM workers and prominent sportsmen are becoming stronger each year and the visits of the country's combined teams and olympic champions have already become a tradition.

Let us talk in more detail about the characteristic features of the construction and installation work on the BAM. We have already talked about the severe and complex natural climatic conditions of the route. Let us emphasize only that sections with tectonic faults and severely cracked rock and also avalanches and slides present the greatest complexity in the mountain regions of the railroad. It is because of this that approximately 3,000 antislide and antiavalanche galleries and more than 3,000 bridges and water pipelines have been constructed. The total volume of excavation work comprises more than 460 million m^3, including 362 million m^3 on the roadbed. We note that the BAM route is characterized by the total absence of roads, which required the construction of approximately 3,000 km of highways along the route, many sections of which are used not only for construction but for transport of freight to the remote regions of the BAM as well.

The enormous volumes of work and the compressed deadlines for completing it resulted in synchronous construction on a very broad front. The railroad is being constructed simultaneously from Komsomolsk-na-Amur and Urgal in the western direction, from Ust-Kut and Severobaykalsk in the eastern direction and from Tynda in the western and eastern directions. Work on the approaches to the railroad (the Bam-Tynda and Tynda-Berkakit lines and the double tracking of the Tayshet-Lena line) and also on the production base facilities of the BAM were organized with the beginning of work on the mainline itself.

For the first time in the practice of Mintransstroy, Glavbamstroy was redeployed directly to the mainline--to Tynda--in 1975 to coordinate management of such enormous construction and for operational making of organizational and engineering decisions.

The capacities of the construction organizations of Glavbamstroy were increased essentially during four years (1974-1978). The number of construction subdivisions during this period increased fivefold while the number of workers increased fourfold. As early as 1978, they Glavbamstroy system numbered more than 100 construction and installation organizations and approximately 60,000 workers. During the same period, bridge builders and tunnel builders were organized and began to work.

The workers and engineering and technical personnel practically lived in tents and railcars initially at each construction site where an "assault" of builders was made, and temporary settlements of wooden panel structures were then erected (locations for them are clearly defined by the general plans). Apartment buildings, children's institutions, department stores and other facilities, assembled from these structures, have given a good account of themselves under the severe conditions of the BAM. Structures for location of the construction equipment and machinery and for installation of boiler rooms and mobile electric power plants were erected at the same time. It is very important that, along with development from the first days at each BAM terminal, work was begun on construction of its basic facilities.

A large amount of Soviet and imported construction equipment, materials and structures arrived at BAM during 1974-1976. At the end of 1976, there were approximately 700 excavators, more than 1,500 bulldozers, graders, self-propelled rollers and special construction and road machines, more than 12,000 trucks and also a considerable number of special mobile automatic shops, trailers, bulk motor transport equipment, hoisting machines and mechanisms on the construction site. The characteristic feature of BAM construction is its high power available per worker. By 1981 it comprised more than 17 kW per worker throughout the organizations of Glavbamstroy. But since very little special construction equipment for operation in permafrost soils and under very low temperature conditions is yet being produced, Glavbamstroy specialists had to additionally solve very complex problems in working out the technology of construction, especially when creating the roadbed and engineering installations.

A high level of mechanization of the basic construction work was achieved within a short period on the BAM as a result of a constant search for solution of new and complex engineering problems. Thus, 99.8 percent of excavation work, 98.9 percent of loading and unloading operations, 99.1 percent of installation of concrete and reinforced concrete structures, 99.6 percent of concrete preparation and 100 percent of assembly of the rail-crosstie grid and installation of the track superstructure are performed by the complex mechanized method in the construction organizations of Glavbamstroy. This made it possible to complete the planned volumes of construction and installation work within the established deadlines and also to turn over individual sections of the mainline, a considerable number of production facilities, more than 500,000 m^2 of capital housing and also children's institutions, schools, hospitals and so on for permanent operation.

All this became possible due to the fact that the party, trade-union and Komsomol organizations and the economic managers resolved the main problems within a short period: they formed strong efficient collectives, consisting basically of youth that came to the construction project on Komsomol leaves; a socialist competition was widely organized, the brigade contract method (44.2 percent of the work) was introduced in construction and all conditions were created for a creative engineering search. As a result, labor productivity at Glavbamstroy increased by 30.6 percent during the 10th Five-Year Plan.

The most progressive engineering solutions were born and are being widely used on the BAM as a result of the creative cooperation of the builders and scientists.

An essentially new design of the footings and body of bridge supports--columnar supports of industrial manufacture--has been developed for the first time in the worldwide practice of bridge building. The method of trenchless construction of the footings for the supports and abutments and of erection of medium and small bridges on the basis of these designs found wide application in construction of the railroad trestles. More effective caissonless footings on shell pilings three meters in diameter, nonsectional metal span structures with welded elements connected on high-strength bolts and nonballast trestle bed on reinforced concrete slabs are used in the designs of large bridges. The use of a new thrust design of bridges made it possible to reduce their length considerably and to reduce the cost of small bridges to two-thirds.

A technique for erection and the design of the roadbed of the route, which passes through permafrost conditions over moraine swampy sections, were developed jointly with representatives of applied sites of central and Siberian scientific research institutes related to construction. The completed roadbed is mainly stable, but to achieve this, the designs of a roadbed operated under similar conditions were studied and many theoretical calculations were made. Thus, a stable and economical design of the base of railroad track was created as a result of the creative cooperation of designers and scientists of Leningrad, who modelled individual sections of the roadbed, located under extreme conditions of the thrust vigorous and capricious rivers as the Larba, Nyukzha, Olekma and Khani. The essence of the search resulted in precise determination of the overall dimensions of the fill, correct selection of the underlying and fill materials and also of the drainage structures.

The technology of drilling and explosive operations in permafrost soils and using shaped charges was worked out and introduced for the first time on the BAM in the practice of railroad construction. It significantly conserves explosives and guarantees the stability of banks without additional working of them with machinery.

The technique of high-speed excavation of rocky railroad recesses was introduced so as to perform enormous volumes of excavation work within compressed deadlines. It includes simultaneous drilling and explosion of several benches, as a result of which there are no offsize pieces in the exploded rock, while excavation of the soil from each bench is carried out with the most productive loading equipment.

Construction of the foundations of industrial and civil buildings under permafrost and rocky soil conditions required creation of new effective drilling equipment. And this equipment was developed. The BTS-500 and TBS high-performance rigs for drilling boreholes by the rolling cutter and thermomechanical methods were tested and put into construction practice on BAM facilities.

The innovators proposed and introduced channelless laying of pipelines with monolithic insulation of the pipes in construction of Shimanovo construction industry. Cold-resistant non-hygroscopic cast asphalt-keramzit-concrete, developed by the Riga branch of the Teploelektroproyekt Institute, is used as the insulation.

A creative approach to solution of specific problems on the BAM was also manifested in widespread use of progressive metal corrugated pipes instead of rectangular reinforced concrete pipes for small water lines. More than 4,300 tons of this pipe was installed on the route during the 10th Five-Year Plan alone.

Scientists from Novosibirsk and Khabarovsk investigated ice formation on the route for a long time, and as a result have already developed a number of anti-icing devices that reliably protect the BAM structures.

The BAM innovators are making a significant contribution to solution of engineering problems. Spare parts are being manufactured and individual assemblies and units of imported and Soviet equipment are being renovated by the engineers, technicians and workers. More than 25 million rubles were saved during the 10th Five-Year Plan because of the innovators of Glavbamstroy.

The socialist competition plays an important mobilizing role for all BAM builders. Effective solution of the large-scale and complet problems which occurred on this construction site required a search for new forms of the socialist competition. The following were added to the traditional forms of the competition (individual, between sections, between construction and installation trains and between mechanized columns): agreements between brigade and subdivision collectives, a competition for the right to lay the last cubic meter of concrete (of soil, railroad section and so on), for the right to be an honorary passenger of the first train, for a thrifty attitude toward entrusted equipment, for conservation of fuel and lubricating materials and spare parts and competitions under the slogans "I am a master of the construction project," "operate on entrusted equipment to the end of BAM construction" and "Let us build ahead of schedule and let us develop ahead of schedule." A total of more than 90 percent of the workers participate in all forms of the competition on the BAM.

The almost 8 years experience of BAM construction indicates the need to solve a number of specific problems to improve the technical direction of the capital construction carried out here. They are related to mechanization of construction, to use of structures and materials, to design and research work, development of construction subdivisions and to creation of enterprises of the construction industry. Let us present the basic recommendations.

Construction equipment and mechanisms in the northern version, which not only correspond to the construction conditions by the quality of metal and fuel and lubricating materials, are needed on the BAM and in other regions of Siberia and the Far East, they guarantee trouble-free operation of the engines at the lowest winter temperatures, but they also create normal conditions for the work of the operators. It is extremely necessary to create powerful Soviet bulldozer equipment (300-500 horsepower) with rippers for excavation of permafrost soils.

Industrial structures that require minimum labor expenditures on the construction site (prefabricated modular units and assemblies of total plant readiness), ness), must be used to the maximum to construct buildings and structures.

One of the weakest points revealed during construction and operation of BAM facilities is the inadequacy of geological surveys conducted by the planning institutes. Their nonconformity to real geology is a rather frequent phenomenon. Normative documentation that regulates the volume of geological surveys under conditions similar to the BAM should be reviewed with regard to the experience accumulated on the BAM. Practice showed that the disposition and configuration of the structures of railroad junctions and stations should primarily be subordinated to geological conditions.

The landscape is completely altered when constructing stations and settlements near them on significant territorial areas (excavations are arranged, roads are laid and surface runoff is regulated). Communications lines, building foundations, underground structures and so on are laid in permafrost. The experience of construction on the BAM in the presence of a so-called inert frozen state showed that significant changes of the hydrogeological and geocryological structure of soils occur on the territory of settlements after 1.5-3 years, which results in partial deformations of buildings and structures. Without excluding the specific effect of unsatisfactory operation of buildings and also the facts of the low quality of design and construction, we note that the causes of the deformations lie considerably deeper: the natural environment is changed during construction and operation of buildings and structures. The problem of predicting the behavior of buildings and structures in permafrost soils requires the most rapid solution.

We feel that all the buildings and structures under the natural climatic conditions of the BAM zone should be constructed from standard designs specially developed for this region and that take into account all the negative phenomena which may affect the stability and durability of structures. The planning institutes are now essentially adapting different designs developed for other regions of the country. The following are provided in some of them: installation of floors and partitions on fill soils, the presence of a significant number of underground spaces, traditional materials for heat insulation and waterproofing and so on. All this is hardly justified under BAM conditions.

Experience showed that construction of the BAM was complicated to a significant degree by the fact that the construction industry base was created parallel with construction of the basic facilities of the railroad. Thus, the Shimanovsk complex of the construction industry began to produce products only

in 1977, whereas the approaches to the BAM (the Bam-Tynda and Tynda-Berkakit Rail Lines) were already basically constructed and the products of the combine for them were essentially unneeded. This also resulted in the fact that the majority of housing and civil facilities were constructed through the efforts of patronage construction organizations for materials and structures imported to the BAM from various republics, krays and oblasts of the country. Multipurpose buildings of total plant readiness of lightweight structures with efficient insulation justify themselves for production needs. The increased requirements on the conditions of living and working comfort and also on environmental protection indicate the need for the most rapid development of mobile boiler plants and mobile purification plants with standard engineering systems and with sectional-removal heat insulation and waterproofing.

Improving the management of capital construction is one of the nodal problems of the sector. A significant place is allocated to the construction complex, the effectiveness of which is related both to organization of construction activity and to formation of optimum proportions of production and consumption in the region of structural members, materials and parts, in implementing the program for economic development of the BAM zone. The organizational structure of management of the construction complex depends to a considerable degree on specific forms of specialization and cooperation. Mintransstroy, Minergo SSSR, Minugleprom SSSR [USSR Ministry of the Coal Industry], Minpromstroy SSSR [USSR Ministry of Industrial Construction] and Minvostokstroy [USSR Ministry of Construction in the Far East and Transbaykal Regions] are now participating in the construction project of the BAM zone. Since the BAM zone is an essentially undeveloped territory, clear interaction and coordination of the work of the construction organizations of these ministries with regard to specialization are required.

Systematic work is being conducted at USSR Mintrasstroy to improve the organizational structure, methods and means of management. New construction and installation trusts are being formed and their productive capacities are being increased intensively to assimilate the growing volumes of capital investments in the country's eastern regions and in future directions. A total of 13 trusts was organized on the BAM during the 9th and 10th Five-Year Plans alone and new trusts were created in Western Siberia, Northern Kazakhstan and the Volga area. The structure of the trusts is also being improved: the offices of material and technical supply are being replaced by production and technological makeup administrations and repair and rolling bases are being replaced by mechanization administrations; specialized subdivisions are being organized to perform sanitary engineering and electrical installation work. The main cost-accounting section of the administration in transport construction are the construction and installation trusts (construction administrations).

The construction and installation trust is characterized as a management facility by great complexity, which is determined by the significant volumes of construction and installation work and by the number of subordinate construction organizations, by dispersion of primary organizations, by separation of facilities under construction by hundreds and thousands of kilomters from the administrative organizations and by a large number of facilities being

constructed simultaneously. Constructing transport facilities in sparsely developed regions, the trust of Mintransstroy should organize the work of not only production but also of housing and municipal services, cultural and service, commercial, medical and other organizations.

The practice of BAM construction shows that there is now an acute need to intensify the middle management section of construction (the trust, construction administration, mobile mechanized column and so on), to create departments and services for introduction of new technology, engineering preparation of production, traffic safety, labor protection, environmental protection and also economic laboratories and so on.

Successful solution of all these problems will undoubtedly contribute to improvement of the construction of transport facilities, to reduction of the periods and to an increase of the quality of BAM construction and of other structures in the country's eastern regions.

Timely Problems of Town Building That Occurred During Economic Development of the BAM Zone

A qualitatively and more complex phase began in solution of town-building problems on the BAM with the beginning of the 11th Five-Year Plan. After all, whereas all populated points on the mainline were built as housing settlements of railroad workers near the stations during the first phase of design and development of the BAM, separate enterprises of different sectors of the national economy related to development of these resources began to be formed around many settlements as geological surveys were accumulated and as the reserves of natural resources were refined. All the newly constructed ministries are actively included in the work on design, construction and operation of production and housing and municipal facilities, which requires clearer coordination of their activities. There is an urgent need to have a unified plan of operations for all participants in development of the BAM zone that determine the basic directions, volumes, periods and degree of contribution of each of them in development of the economy and culture of this vast region.

The main town-building document that determines the most efficient organization of the territory and formation of the system of settlement in the BAM zone is now the General scheme of regional layout of the sphere of influence of the BAM, developed by the Giprogor Institute. According to this document for long-term planning in the BAM zone, the following industrial regions will be developed:

1. Verkhnelenskiy. This is a chain of industrial cities along the Lena River (Ust-Kut--Podymakhino, Markovo and so on) and along the Kirenga River (Kazachinskiy and so on) that specialize in extensive mechanical and chemical processing of wood, the chemical industry, hydraulic engineering production and also in major navigation along the Lena River.

2. Vitimskiy Rayon consists of two industrial complexes--the Bodaybo and the Mama. The proposed construction of the hydroelectric power plants on the Vitim River will have a significant effect on its development.

3. Severo-Baykalskiy. The rayon is located in the vast Baykal natural park. Therefore, development of sectors of the national economy should be combined here with a wide complex of measures for environmental protection and use and to creation of a large resort and recreation zone.

4. Severo-Buryatskiy. A very significant mineral and raw material potential has been determined in the rayon, as in the northern Transbaykal region, which permits development of several industrial complexes specializing in the mining industry. To eliminate the harmful effect of production on the nature of the Transbaykal, the designs of the industrial enterprises of this rayon should be worked out on the basis of wasteless technology, advanced construction of purification plants and careful purification of industrial and household wastes.

5. Severo-Chitinskiy. The rayon is being formed by development of the largest Udokan copper-ore mining concentration combine and due to development of other sectors of the national economy.

6. Yuzhno-Yakutskiy. The rayon is characterized by a high concentration of effective natural resources that create the basis for extensive industrial development. Large industrial complexes--the Chulman-Neryungri with the cities of Chulman and Neryungri (coal mining, ferrous metallurgy and possibly coal tar-chemistry), the taiga (iron ore mining and concentration), the Aldan and Tommot (mica and the woodworking industry) and the Olekma (rock salt mining and timber processing) are being formed here.

7. Zapadno-Amurskiy. The rayon specializes in procurement and processing of wood but, it is also becoming a major transport junction. Large enterprises for repair and maintenance of rolling stock will be created and sectors of the local and food industry will be developed at Tynda, where the administration of the Baykal-Amur Railroad is located. The rayon is very convenient for development of a powerful base for the construction industry for the entire BAM zone.

8-9. Zeysko-Bomnakskiy and Verkhneselemdzhinskiy. These rayons can be developed on the basis of procurement and extensive processing of wood and iron ore and other mineral mining.

10. Urgalskiy. Its nucleus is the industrial complex formed on the basis of mining the Verkhnebureya coal field and also procurement and processing of wood (Urgal, Chegdomyn and others).

11. Komsomolsko-Amurskiy. This is a large and the most developed rayon in the BAM zone, which includes industrial complexes and cities that are being developed intensively: Komsomolsk (machine building, ferrous metallurgy and petrochemistry), Amur (the pulp and paper industry) and Solnechnyy (the mining industry). Located under relatively favorable natural conditions and provided with water resources, the rayon has significant opportunities for development of the processing industry.

12. Sovetskogavanskiy. It will be developed upon formation of future industrial complexes linked to the Pacific Ocean ports of Sovetskaya Gavan and Vanino.

13-14. The Nizhneamurskiy and Turguro-Chumikanskiy industrial rayons, Khabarovsk Kray, development of which will also become possible in the future. The development of these rayons will permit new natural resources (timber, minerals and hydroenergy) to be brought into operation.

The specific feature of the BAM zone is the vulnerability of its environment, specifically related to permafrost distribution. The capacity for self-purification of the water and soil here is considerably lower than in the central zone of the European USSR. In this regard, the danger of possible deterioration of the environment and the occurrence of chains of negative changes in disturbance of the thermal conditions and pollution of the soil, rivers and water-bearing levels must be taken into account in design and construction of populated points.

The most important condition of the General scheme for regional planning of the sphere of influence of the BAM is the use of a flexible planning structure for the cities and settlements being developed and a guarantee of the reserves of their settlement territories, since a new town-forming base must occur as a result of study and development of the most abundant natural resources of the zone and the volumes of construction will increase. It is for this reason that reserve territories were provided during the first stage of development of the general plans of the cities and settlements of the BAM in their architectural and planning structure, which also made it possible for futher harmonious development of populated points.

However, a number of conditions and factors occurs in practice that interfere with correct solution of town-building problems. They have been discussed repeatedly in the press.*

First, there is no unified customer in many cities and settlements of the BAM which would combine and coordinate the efforts of different departments. Second, most of the new builders have no limits of contract work at Mintransstroy, which is supervising the housing and civil construction in the BAM zone. Finally, there are also other builders which simply do not wish to create capital, well-organized buildings and structures here. Thus, 15 forest management industries, belonging to different departments including the Ministry of Agriculture, Kazakh SSR, Glavsnab [Main Supply Administration], Tadzhik SSR, Sel' khozteknika, Kirghiz SSR, Minlesbumprom [Ministry of the Timber, Pulp and Paper, and Wood Processing Industry] and so on, are now operating in the Irkutsk section of the BAM. All of them, without taking into account the general plans for construction of populated points, are erecting "their own" temporary settlements of rapidly assembled wooden buildings (huts) and are not developing

*N. Sukhanov, "Cities on the BAM," PRAVDA, 12 December 1981.

engineering systems and cultural and service facilities. It is clear that this approach does not correspond to the problems of highly effective development of the BAM zone.

Ways must be found that contribute in the best manner to intelligent solution of town-building problems. An important document for this should become the "Complex specific program for development of the national economy in the BAM zone, which is now being worked out by USSR Gosplan with participation of the Siberian Department, USSR Academy of Sciences. This program has been called upon to overcome the departmental barriers and to combine the activity of all participants and partners in development of the BAM zone. It should not only determine the extent of the contribution of one or another ministry or department, but should also dictate the qualitative characteristics of the town-building environment and the material and technical base being developed.

Of course, it would be considerably easier to form a complex social environment on the BAM if the capital investments for housing and civil construction were allocated in a centralized manner, rather than through departmental channels. But it is difficult to count on this. The most realistic method is to create the services of a unified customer in the cities and settlements of the BAM. The example of the construction of Tynda and Ust-Kut convincingly demonstrated that the board of directors for construction of the BAM will not perform the functions of a general customer at relatively large populated points where the interests of many sectors and departments converge. In any case, the Ministry of Railways refuses to take on the duties of "town-building director." And this results in the fact that no one is involved to the proper degree in problems of the design and construction of general municipal heat supply, water supply and sewer systems. The facilities constructed for the needs of the railroad workers do not support the ever increasing needs of the population. For example, the majority of the town-forming base at Tynda is comprised of transport builders, the numbers of which exceed almost threefold the calculated number and comprised 19,000 persons, rather than railroad workers. However, neither capital construction nor cultural-service and municipal service facilties are generally being planned for them.

Unified customer services must be created in the developing cities and settlements of the BAM that are attached to the ispolkoms of the local Soviet of working peoples deputies and they must be maintained at the expense of funds from different builders. This problem was raised on a very timely basis by PRAVDA in an article entitled "A City is Being Built" (1 and 2 August 1981). As before, the board of directors of BAM construction cannot perform the functions of a general builder in small settlements that are not being intensively developed. Relying on the rayispolkoms and the services of regional architects, it should place the appropriate town-building and engineering and construction requirements on the builders. In all cases, the important responsibility for harmonious development of the cities and settlements of the BAM and for clear observation of town-building discipline lies in the republic, kray, oblast, municipal and rayon organizations for construction and architectural affairs.

The experience of design and the practice of building cities and settlements in the BAM zone will undoubtedly become a significant contribution to solution of the complex town-building problems in the northern regions of eastern Siberia and the Far East, distinguished by especially complex conditions. But regardless of how complex the town-building problems are, the most complex problems in economic development of the BAM zone remain creation of a construction industry base and organization of a construction contractor. Many years of experience of developing the new regions of the Arctic and east of the country indicates that organization of construction was always one of the weakest links in the chain of economic problems, due to which interruptions of the intended plans and deadlines most frequently occurred. The status of the construction complex in the BAM region is now characterized by the level of concentration of construction and departmental dispersion. Unfortunately, this key question of the economic development of the region is not being adequately developed either in the scientific centers or in the planning and economic organizations, which was discussed at the Third All-Union Scientific and Practical Conference on Problems of Economic Development of the BAM Zone, which was held in September 1981 at Ulan-Uda.

It is difficult to agree with the fact that a dependable construction industry must be developed in the BAM zone by reorientation of subdivisions of Mintransstroy from transport construction to the needs of production and housing and civil construction for different sectors of the national economy. We feel that this is a simple approach and a serious delusion: Mintransstroy specializes in construction of railroads, highways and airfields; therefore, this production base is very specific. With regard to the local production base for housing and civil construction, it is not yet in the final stage of formation. We have already indicated that one shop of the Shimanovo Construction Materials Combine, which manufactures large-panel apartment buildings for the cities and settlements of the BAM, was put into operation three years late. The introduction of the Tayshet Construction Industry Combine (the products were supposed to be used in construction of Ust-Kut and Severobaykalsk and Uoyan, Angoya and other settlements), planned for 1977, also did not come about and it is now clear that the combine will be started up no earlier than 1985. Only one-fifth of the planned work has been completed on constructionof of such an important facility as the brick plant at Bam Station. It follows from all this that one cannot count only on the efforts of Mintransstroy in the economic development of the region.

The question of through the efforts of which construction organizations the material and technical base of the territorial and industrial complexes being created in the BAM zone will be formed and through whose efforts new large enterprises will be constructed arises.

The decision to create an All-Union Ministry of Construction in the regions of the Far East and the Transbaykal should be regarded as the answer to this question. The main responsibility for development of the branched system of contract construction organizations, capable of fully meeting the needs of development of all the sectors of the national economy and of populated points in the BAM zone, is entrusted to it. This ministry as yet has no future plan for development of the construction industry base and the contract sections in

the regions of proposed development of the BAM zone. And after all, one must prepare beforehand for construction of such important industrial complexes as, for example, the Udokan mining and industrial combine, and one must create a construction base, housing settlements for the builders and so on at the expense of the customer and the contractor. The other ministries, which must increase the volumes of construction production in the BAM zone (Minenergo, Minmontazhspetsstroy, Minugleprom, Minsel'stroy and so on), are faced with no less important problems in this plan. The USSR and RSFSR Ministries of the Construction Materials Industry are still not solving the problem of economic development of the BAM zone--they are not planning for the necessary increase of cement and brick production prior to 1990.

All this indicates that there will be no significant growth of the capacities of the construction complex in the BAM zone during the 11th Five-Year Plan. And if the existing principles of planning and organization of construction are not changed, then this may have a negative effect on fulfillment of the plans of the 12th Five-Year Plan. That is why the section for disposition and development of contract construction sections and enterprises of the construction materials industry should become the main item in the Complex specific program for development of the national economy in the BAM zone with precise definition of where, when and in which volumes they should be created and which ministry and department is responsible for this.

The scientific council on problems of the BAM, USSR Academy of Sciences, has worked out a scientifically based concept for development of the construction complex in the BAM zone. It envisions the introduction of progressive labor-saving technology and organization of construction, supply of construction equipment in the northern version and the maximum possible use of prefabricated elements and assemblies of complete plant readiness, the method of conveyor assembly of structures and unit installation of them, introduction of the watch and expeditionary methods of construction and an optimum combination of development of permanent construction bases and transport of effective construction materials and structures from other regions of the country. It is very important that these correct propositions be taken as arms by the planning organizations and ministries responsible for economic development of the BAM zone.

L. I. Brezhnev noted at the 26th CPSU Congress the need for further improvement of the management of territorial industrial complexes for the best combination of regional and sector interests. In this regard, we feel that it would be feasible, by analogy with the Western Siberian oil and gas complex, to create an interdepartmental committee of USSR Gosplan for the BAM zone.

There is no doubt that the decision of the 26th CPSU Congress on opening train traffic over the entire length of the Baykal-Amur Mainline Railroad during the current five-year plan will be fulfilled. Survey operations are already being conducted actively along the railroad route that continues the "small BAM"--from Berkakit Station to Tommot and Yakutsk. The plans for new industrial complexes, designs for the layout and construction of new cities and settlements, which will become the centers of the economics and culture of the BAM zone that create ever increasing conditions for labor, services and recreation of the people developing this severe, but beautiful kray, are being worked out.

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The BAM and the Dirigible

The history of development of Siberia is characterized by the large scale of the phases.* The famous Transsiberian Railroad--the first railroad of Siberia --brought to life the southern economic zone. Settlements that contained 90 percent of the population of the vast region developed in the zone of this railroad. Economic development of the BAM is the primary and as yet most important phase of development of Siberia and the Far East. The BAM zone already comes close to the territory of the so-called Near Arctic. The scientific bases for further development of Siberia (including the BAM zone) were developed by the scientists of the Siberian Department, USSR Academy of Sciences, as part of a multisector large-scale complex program that has been named "Siberia." The program has already been partially implemented. Its firstborn is rightfully regarded the southern Yakutsk territorial and industrial complex and subsequent phases are being extended even into the 21st century. However, working out an even more grandiose program for development of the Arctic territories of the country, which has received the short, but indicative name "Arktika," is still in the view of Siberian scientists. It will far exceed the scales of the BAM in the volumes of work and the proposed capital investments.

Reflecting the grandiose nature of the plans and of the colossal territory for which it is intended, the "Arktika" program also generates a set of the most complex problems, solution of which is impossible by traditional procedures.

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*Vladimir Mikhaylovich Dynin is an architect and deputy chief of the Main Administration for Planning and Construction of Cities and Urban-Type Settlements of RSFSR Gosstroy. He was chairman of the section of aerostat equipment of the Yakutsk Oblast Council of NTO [Scientific Organization of Labor] during 1970-1980. He is the author of a number of publications on the problem of using aerostat equipment for transport.

The main one of them is the problem of transportation. After all, it is extremely complicated and expensive to construct roads, railroads or highways in the Far North and even more so on the coast of the Arctic Ocean. The navigation season along the Northern Sea Route, due to modern nuclear-powered icebreakers, approaching a year-round season, is solving only part of the problem. Research is under way to carry out a navigation season on Siberian Rivers. Proposals are being advanced for under-ice navigation. Tract "snowmobile" transport is being developed. The hovercraft is beginning to win its place. Traditional types of transport--rail, motor and river--will go through further modernization. The leader of technical progress still remains the beloved Arctic aviation. But among the world-renowned transport equipment, there is also one type which would bring special benefit to the vast spaces of our country. We are talking about the most ancient type of air transport--the dirigible.

Being born at the dawn of development of aerospace, dirigibles and balloons have undeservedly gone out of vogue. The hot and cold wars of our century distorted the paths of development of aerial navigation, giving preference to aerodynamic flying vehicles--aircraft and helicopters.

The problem of using a dirigible as highly efficient transport equipment is not a new one. Our compatriot, the great K. E. Tsiolkovskiy, devoted more than half of his labors to the dirigible. Here are only a few of his predictions with respect to the idea of using "controlled aerostats," as he loved to call dirigibles:

"If a way could be found to make the shells of aerostats impermeable and inexpensive and if one could learn to use air currents, then this method of movement would be the most economical in the world."

"Make a silver aerostat and it will return 100 percent of net profit for the expended capital; even an aerostat of pure gold will yield an excellent percentage."

"I am confident and I know that Soviet dirigibles will be the world's best," Tsiolkovskiy wrote with such confidence in the future of the dirigible even during the early part of the century. But, unfortunately, much has been written about Tsiolkovskiy as the father of cosmonautics" and only few know about his multifaceted, diverse talent and even fewer know about the fact that he devoted the major part of his labors to his beloved child--the dirigible. However, the historical fact is that the first and last work of Tsiolkovskiy was devoted to the dirigible. That is why the photographs that have come down to us indicate that if Tsiolkovskiy was photographed in his workshop, he would inevitably be surrounded by models of dirigibles, in which the scientist's idea not only would be embodied, but which he had made with his own hands (see page 3 of the cover, top).

Dirigible construction began to be developed in our country during the early 1930s, although there were some attempts to construct dirigibles and balloons even during pre-Revolutionary times. The Soviet Dirizhablestroy constructed several relatively small dirigibles. The flagship of Soviet dirigible

construction--the dirigible V-6 Osoaviakhim--established a world record in 1937 for a nonstop flight, without refuelling and replacement of the crew, having stayed almost 5.5 days in the air, or rather 130 hours 27 minutes (see page 3 of the cover, below left). The dirigible is now a different structure, similar to prewar dirigibles only in shape and hull dimensions. The development of science and technology armed the modern developers of dirigibles with excellent structural materials and the chemical industry armed them with the strongest films, capable of making the gasbags effectively impermeable, as Tsiolkovskiy dreamed.

The research related to dirigible design is now inevitably accompanied by economic calculations. After all, a dirigible must be developed which could compete successfully with existing types of transport. According to calculations of the Kiev Public Office for Aerial Navigation, a dirigible of class D-4--the final version of a series of smaller dirigibles (see page 3 of the cover, below right)--that will have these characteristics. Its main structures are a glass-fiber-reinforced fuselage. The tanks for the supporting gas (helium) are manufactured from high-strength synthetic fuel (bull hides were used for this in old dirigibles). The propulsion unit is based on serially produced aviation motors that rotate propellers located in the rudder control ring. The configuration of these systems in the stern and bow of the dirigible permit it to maneuver almost in place. Kiev engineers have developed several special systems needed especially for the dirigible on the level of inventions. Especially important ones of them are patents for the design as a whole, for the envelope and for the method of manufacturing it, for the technology of assembly and working with cargo and for mooring and the berthing-parking complex that permit the dirigible to "set down" in "zero" visibility and if necessary in the center of cities.

To imagine the economic advantages of the D-4 dirigible with respect to, let us say, a region such as the Yakut ASSR, it is sufficient to name the actual cost of one t-km when using other types of transport: it comprises 170-250 kopecks for a helicopter, 33-62 kopecks for an aircraft, 8-32 kopecks for motor transport and 3 kopecks for the D-4 dirigible. Thus, a dirigible of the D-4 class will be more economical even than motor transport, for which a road is also necessary and the road is very expensive in Yakutiya. Its other indices are also amazing: it has a volume of 220,000 m^3, load capacity of 125 tons, nonstop flight range up to 7,000 km and cruising speed of 170 km/hr.

But cargo transportation is only half the matter. After all, cargo should also be unloaded from transport equipment loaded into it if necessary. It is these very capabilities that modern dirigibles will have. Having all the necessary equipment on board, they not only deliver cargo "from door to door," but they help to store it where needed and to assemble it if this problem arises. The universal nature of the dirigible naturally generated the idea of developing a balloon transport-installation apparatus and following it the idea of developing the country's new air transport system, and not only a transport system, but the widest range of aerostat devices capable of solving the most diverse problems, if not in every sector, then in most sectors of the national economy. The idea of multifaceted, universal use of aerostat equipment resulted in the following idea: the need to develop a new sector of technology--aerostat equipment.

This term has not achieved its encyclopedic interpretation. We understand aerostatic equipment as the vast area of technology, the basis of which is the supporting gas (including air) that holds the aerostat equipment in the air or permits the aerostat ground installation (pneumatic structures) to perform their functions. Aerostat equipment can be divided into two main types: airborne equipment and ground aerostat installations. The first in turn can be based on flying vehicles and stationary type aerostat equipment. Flying aerostat equipment is the basis for aerostat transport equipment. They can be designed as self-propelled or moved by other transport equipment, including the use of dirigibles.

The aerostat transport-installation equipment designed at the same Kiev public design office for air navigation is of special value to builders. The Inventor's Certificate, received by the Kiev inventors for assembly of structures using a dirigible, indicated the innovation of this technical idea.

The other work of the Kiev engineers--suppression of winds at an altitude of 6-8 km by creating so-called tropopause wind electric plants--is no less unique. Their basis is also the dirigible fuselage.

One can talk very much about the varieties of aerostat equipment, but let us return to the topic "the BAM and the dirigible."

Let us imagine the possible scheme for deployment of dirigible flotillas along the BAM route and the possible radii of servicing the territories located north of it. Let us proceed in this case with the optimum service radius of the D-4 dirigible, equal to 1,500-2,000 km. This service radius permits the dirigible flotillas to be located at only two points: Ust-Kut and Komsomolsk-na-Amur so as to service the greater part of Krasnoyarsk Kray, the Yakutsk ASSR, Magadan Oblast, Sakhalin and Kamchatka. If one takes into account that the railroad will reach Yakutsk as well in the future, the capability of transport servicing of the northern territories will increase even more.

Dirigible flotillas, of course, can be deployed where necessary, but the BAM is obviously the most preferable version of deploying them since freight is delivered here by rail. The Bamodirizhabl' transport system could guarantee delivery of any cargo to any point of Eastern Siberia and to the northeast of the country.

In conclusion, I would like to again recall the brilliant K. E. Tsiolkovskiy, who was distinguished by inspired fantasy, the depth and complexity of prediction, the sharply critical makeup of his mind, the pedantic nature of mathematics and the soberness of an engineer-designer. One can be confident that his trust in Soviet dirigibles and in the enormous potential capabilities of a "controlled aerostat" will find fruition in the near future, as his dreams of the conquest of space have already been implemented.

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6521
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OCEAN AND RIVER

INEFFICIENT USE OF LABOR, FUEL NOTED

Moscow AGITATOR in Russian No 13, Jul 82 pp 35-37

[Article by V. Fomin, chief of the sector for development of water transportation equipment of the Institute of Intermodal Transport Problems of USSR Gosplan, candidate of engineering sciences: "High Efficiency for Water Transportation: Development of a Method"]

[Text] If we are to judge by the size of the work force, water transportation's place in our national economy is a very modest one--in 1980 there were 433,000 people working in it. But there is a point to the folksaying that a gold piece is small but valuable: armed with mighty up-to-date equipment, the workers on the blue highways perform a tremendous amount of work indispensable to the country. In that same year, 1980, maritime transport carried 228 million tons of cargo over an average distance of more than 3,700 km. The rivermen carried 568 million tons over an average of 431 km. How is one to represent such an amount of cargo? It is more, for example, than the annual output of iron ore, steel, cement, grain and sugar beets taken together.

Water transportation's cargo traffic has been growing steadily (in billions of ton-kilometers):

Sector	1950	1965	1980
Maritime	40	389	848
River	46	134	245
Total	86	523	1,093

We might comment on the last total by making this comparison: at the present time the cargo traffic of ships alone is equal to what was carried in the mid-fifties by common carriers in all the branches of transportation.

At present watermen account for about 18 percent of all the shipments of Soviet transportation. This is also quite a bit, but it is important to note that their role is far greater in certain spheres of activity. For instance, the share of water transportation (mainly maritime transportation) in our export-import shipments is more than half, and in 1980 vessels of the Soviet merchant fleet visited 1,250 ports in 124 countries. The seamen are also

delivering a sizable portion of cargo to our Far North and Far East, having in recent years appreciably lengthened the shipping season by means of mighty icebreakers, including nuclear-powered icebreakers.

The Soviet Union occupies first place in the world with respect to the length of inland waterways. The role of the river fleet is especially important in the regions of Siberia and the Far East. For example, in Tyumen and Tomsk Oblasts its share is more than half of all cargo traffic, and in Yakutia it is four-fifths. Moreover, water transportation is the most economical form. The cost of river shipments in the European part of RSFSR is two-thirds of what it is by rail, and in Siberia and the Far East it is between one-tenth and one-fifteenth as high as by truck.

In the 11th Five-Year Plan the cargo traffic of maritime transportation is to increase 9 percent. Approximately 250 more vessels will be added to the 1,748 vessels which the 16 shipping companies had at the beginning of the 5-year period. Cargo vessels will begin to be furnished nuclear power plants. Year-round navigation will be guaranteed in the western sector of the Northern Sea Route, and traffic in Arctic regions will increase 1.4-fold over the 5-year period.

Plans call for a 19-percent growth of the cargo traffic of the river fleet. Its absolute growth is to be twice as great as in the last 5-year period. Rivermen are receiving up-to-date new diesel motor vessels with large carrying capacity, combined "river-sea" vessels, tugs and pushboats, and icebreakers. There are plans to transfer about 40 million tons of cargo from rail to water during the 5-year period.

Important assignments for water transportation are also contained in the USSR Food Program, approved by the May (1982) Plenum of the CPSU Central Committee. In maritime transportation plans aimed at full support of shipments of foodstuffs call for creating specialized complexes for transhipment of such cargo in the ports of the Baltic, Black Sea and Far Eastern Basins.

The rivermen face the task of shortening the delivery time for vegetables and melons from the regions of the Lower Volga to the country's industrial centers. There are plans to continue the development of docks and fruit and vegetable depots on rivers. The Ministry of Shipbuilding Industry and RSFSR Ministry of River Fleet have been ordered to see to the construction in the 1983-1990 period of 90 river vessels for carrying vegetables and to speed up development and construction of specialized transportation equipment for small rivers.

If the seamen and rivermen are to perform the complicated tasks which have been set them, they need to substantially improve the quality of their performance. Yet many crews and even certain shipping companies are not at present coping with their plans for cargo traffic. Matters are even worse with certain indicators of the efficiency of utilization of vessels.

For example, in maritime transportation utilization of cargo capacity is still rather low and is even deteriorating. For liquid cargo vessels it dropped

from 59.4 percent in 1970 to 58.6 percent in 1980; for dry cargo vessels it dropped from 65.3 to 55 percent. Or take such a summary indicator as output per ton of cargo capacity per day of operation. Over those same 10 years it dropped from 150 ton-miles to 115 for liquid cargo vessels and from 91.1 to 70.8 ton-miles for dry cargo vessels. In the river fleet this indicator dropped from 144 to 131 ton-kilometers for self-propelled oil tankers. In that same sector productivity per horsepower of the tugboat fleet per day of operation dropped from 571 ton-kilometers in 1970 to 431 in 1980 in petroleum shipments and from 312 to 310 ton-kilometers in carrying dry cargo.

In other words, utilization is deteriorating for the large-capacity and, let us not forget, expensive productive capital assets. One of the reasons for this is that many vessels are unfortunately spending a large and even ever increasing part of their time running empty rather than carrying cargo, are standing idle during repairs, during unloading or loading, and in waiting. Correspondingly, for example, in the river tugboat fleet running time with loaded crews was 37.1 percent of all operating time in 1970, and in 1980 it was still lower--34.4 percent. For the self-propelled river petroleum tanker fleet the share of loaded running time dropped over the same time from 31 to 29.4 percent.

This adverse trend has to be overcome. And though by no means everything here depends directly on ship crews themselves, a great deal does after all depend on them. Here is a graphic example from the experience of the Belaya River Shipping Company in Bashkiria. During the last shipping season the cargo motor vessels "Uralsk" and "Kineshma," which are equal in class, operated there under the same operating conditions. But the crew of the "Uralsk" fulfilled its target at a level of 122 percent and had no downtime or breakdowns, while their neighbors on the line did not complete a single trip without incident, spent 34 days idle during repairs, and fulfilled the plan at a level of only 58 percent.

The crew of the motor vessel "Volgo-Don-5009" successfully coped with its plan for the volume of cargo on the line Rostov--Moscow--Leningrad--Perm. On the average it fulfilled its monthly targets at a level of 125 percent, and did not spend time in repairs during the shipping season. "There is no secret here at all," says Captain G. Chugunov, "we are simply striving to improve our professional skills. Every member of the crew clearly knows what his duties are and promptly does the technical servicing of the machinery assigned to him and prepares it for operation. We believe that we can lengthen the period between medium overhauls to 7 years."

And the collective of the motor vessel "Petr Krasikov" on the Baltic committed itself to working without shipyard repairs during the first 8 years of the vessel's operation. This is a very important matter; after all, every day of idle time of this motor vessel costs the state 3,000 rubles. That is why the crew decided to do preventive maintenance under way with its own resources and also to avert breakdowns by painstaking care of equipment and apparatus.

Labor productivity is rising slowly in water transportation. During the last 5-year period the volume of cargo rose 14 percent, but the size of the labor

force also increased more than 7 percent. Thus less than half of the entire growth of the volume of cargo was achieved by raising the average output. Meanwhile hundreds of crews, using the well-known Shchekino method, are widely practicing the combination of occupations and functions and expansion of service zones. This is substantially increasing labor productivity, is making people already trained available for new vessels, and is promoting a rise of wages. This kind of know-how needs to be taken up for use everywhere.

If labor productivity, as has been proposed, rises faster than wages, the labor cost per 1,000 ton-kilometers drops. And wages in the river fleet amount to about one-fourth of the entire prime cost of shipments. Another important way of reducing the prime cost and raising the profitability of water transportation is fuel conservation. In the river fleet, for example, a reduction of just 1 percent of the rate of fuel consumption means a saving of more than 10 million rubles per year.

They conducted a curious analysis in this connection in the Irtysh Shipping Company. In 5 months of the last shipping season the motor vessel "Artemovsk" consumed 5.6 kg of fuel per 1,000 ton-kilometers, and under the same conditions the motor vessel "Yelat'ma" consumed 6.9 kg, the "Omskiy-8" 6.5, and the "Omskiy-5" 7.6 kg, and so on.

There are various reasons here, but it is important to note that the rate of fuel consumption is lower where operating conditions of engines are strictly observed, where speeds are regulated to take into account local conditions of navigation and the situation that arises at points where vessels are to be handled. After all, it is nonsensical for all the vessels to scramble at maximum speed to a port, overconsuming a large amount of fuel in the process, when the time gained traveling is offset by idle time waiting for loading and unloading. When information is available about the situation in the port, it is better sometimes to select the optimum speed and bring the vessel in later.

In every ship's company there are those most important and complicated problems which have not yet been solved. They should be taken up in a discussion, which should cover generally what needs to be done to improve the indicators and how it should be done. With the same--or still better--a smaller crew, with a lower rate of fuel consumption, with lower expenditures of time and resources for repairs, to carry more cargo during the shipping season--that is the principal task.

Much also depends here on partners, on shippers and consignees, on dockers and other port personnel. Those who speak out in those collectives should also emphasize shortcomings which have still not been overcome. For example, in Tyumen Oblast vessels spend about half of the navigation time in ports waiting to be loaded or unloaded. During the last shipping season nearly 9.5 million tonnage-days were lost on that basis; that is equivalent to idling 52 barges with a cargo-carrying capacity of 1,000 tons each for the entire summer. Many shippers deliver their cargo in bulk and use containers and pallets only occasionally. This is an obstacle to mechanization and increases vessel handling time.

Yet the good experience of interaction of all participants in a transportation junction gained in the Leningrad Maritime Port, approved by the CPSU Central Committee, has long been well known. It is worthwhile to recall it to the students who had letters to the editor published in PRAVDA on 16 and in TRUD on 25 February. But the workers in Leningrad also have something to learn from workers in other ports. For example, the productivity of the production line for processing raw sugar in the port of Leningrad is only 170 tons per shift, while in Kaliningrad it is 362 tons. On the other hand the Kaliningrad workers have low productivity in transshipment of citrus fruit: a team of 13-14 members has an output of only 80 tons per shift, while in the ports of Kherson, Odessa and Ventspils, for example, they have increased it to 130-150 tons by introducing larger pallets and using hydraulic roller trucks.

Much in the port is also determined by the skill, thoroughness and conscientiousness of teams of longshoremen and machine operators. In the port of Vladivostok, for instance, vessels are handled rapidly by the mixed work team of V. Dunayev, Hero of Socialist Labor. Even before the vessel arrives, it palletizes the cargo, makes it up into sling loads weighing 3 to 5 tons. Then the cranes quickly stow it in the hold, in such a way, moreover, that it is more convenient for unloading at the port of destination.

In short, there is no shortage, as they say, of good experience in water transportation. There is only a need to study it thoughtfully and introduce it everywhere, showing everyday concern about increasing operating efficiency.

7045
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GOSPLAN OFFICIAL REVIEWS TRANSPORTATION'S DEVELOPMENT

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 9, Sep 82 pp 38-48

[Article by V. Biryukov, deputy chairman of USSR Gosplan]

[Text] Our government has a powerful transportation system at its disposal. The length of the network of means of communication of all types of transport comprises 2.8 million km. The operating length of general-purpose and nonstandard railroads increased more than twofold during Soviet power and comprises 283,000 km. Almost all the freight turnover of railroads and more than 90 percent of classification work are performed by electric and diesel traction. More than 24 billion tons of freight and more than 26 billion passengers annually are hauled by motor transport and more than 2.4 million motor vehicles are produced annually in the country, of which 700,000 are trucks. The truck fleet increased almost twofold during the past 20 years with a 1.5-fold increase of average capacity. The length of the developed highway system comprises 732,000 km. A pipeline transport system has been newly developed and its length is more than 202,000 km. The length of civil aviation air lines comprises 915,000 km. More than 220 billion rubles was spent on development of transportation and communications during Soviet power, including approximately 70 billion rubles that were spent on rail transport. The main transport funds comprised 240 billion rubles--20.8 percent of the cost of basic production funds and 13.7 percent of the cost of all basic funds of the country's national economy--by the end of the 10th Five-Year Plan. Capital investments for development of transport comprise 10.4 percent of the total in the national economy. More than 16 percent of the basic production funds of the national economy and more than 9 percent of all workers and employees involved in it go to general-purpose transport. Strengthening of the material and technical base of transport made it possible to increase the volume of shipping operations 223-fold in 1981 compared to 1922--the year that the USSR was founded.

The data presented below indicate the dynamic growth of the freight turnover of all types of transport during 60 years of power of the USSR.

As can be seen from the table, along with the growth of freight turnover of traditional types of transport, the fraction of motor, oil pipeline and other types of transport increased significantly.

(1)	(2)		(3)	
(4)				
Железнодорожный	18,2	3503,2	61,6	55,3
(5) Морской	4,2	806,1	14,9	13,1
(6) Речной	5,5	255,1	19,5	1,0
(7) Автомобильный	0,1	151 0	0,4	7,2
(8) Нефте- и нефтепродуктопроводный	0,2	1264,2	0,7	20,0
(9) Воздушный	-	3,1	-	0,1

Key:

1. Type of transport
2. Freight turnover of transport, billion t-km
3. Specific weight, percent
4. Rail
5. Maritime
6. River
7. Motor
8. Oil and petroleum product pipeline
9. Air

Formation and improvement of the country's transportation system are inseparably related to development of the Soviet economy. The young Soviet republic inherited from Tsarist Russia an extremely weakly developed system of means of communication, which at that time was severely destroyed as a result of World War I and the Civil War. The party and the Soviet government implemented a number of emergency measures to restore it. Nationalization of maritime, river and rail transport in 1918 established the beginning of development of the base of the unified transport system, guaranteeing socioeconomic unity of all types of transport.

The GOELRO [State Commission for the Electrification of Russia] plan, in which electrification of the railroads was regarded as the basis for restoration, construction and technical re-equipping of the entire transport economy, played an important role in development of the unified transport system. Characterizing the tasks faced by Russian transport with regard to dispersion of natural resources over the vast territory of the state, the compilers of the plan emphasized "how great the need is in Russia for express and inexpensive transport which would bring remote sections of the republic closer to a single more economically compact body."[1] The following is written in it: "The basic transport skeleton must be routes which would combine inexpensive shipments with extremely high capacity."[2]

Implementation of the idea of the GOELRO plan was begun even during restoration of the economy and was implemented on broad scales during the five-year plans before World War II. Extensive work was completed to intensify the

[1] "Plan elektrifikatsii RSFSR" [Plan for Electrification of the RSFSR], Moscow, Gospolitizdat, p 141, 1955.

[2] Loc. cit.

existing and to construct new rail lines and 13,400 km of new railroads, mainly in the eastern regions of the country,were constructed. The most important of them were the Turkestan-Siberian, Karaganda and Moscow-Donbass. The ties of the Donbass to the country's northwestern regions and primarily with Leningrad were strengthened, due to laying the Bryansk-Byazma and Vorozhba-Orsha rail lines. The ties of the Urals and Siberia were improved significantly as a result of development of the Kazan-Sverdlovsk and Orenburg-Orsk rail lines and also as a result of developing the new Sverdlovsk-Kurgan line. The Troitsk-Orsk line guaranteed communications of the Urals and Kazakhstan. Conversion of the Transsiberian Railroad to a super double-tracked mainline is related to the same period. Significant work was carried out on technical re-equipping and reconstruction of railroad stations and junctions. Heavy rails were laid on almost 33,000 km of main rail lines. Strengthening of the track superstructure (along with measures to improve the roadbed) guaranteed that heavy trains using powerful locomotives and rail cars with increased capacity could be driven. All this made it possible to bring the capacity of the most important mainlines up to 40-50 million tons annually and to increase the average freight intensity of the railroads twofold. Technical re-equipping of the rolling stock of transport became possible due to industrialization and development of a powerful machine building base. The country's railroads had more than 26,000 steam locomotives (mainly powerful and economic marks FD, SO and IS) in 1940 that were capable of pullin heavy trains at high speeds.

Almost 1,900 km of railroads were converted to electric traction by 1941 as a result of implementing the GOELRO plan. The beginning of work to equip the railroad sections with centralized traffic control is related to the same period. The measures implemented in development and technical re-equipping of rail transport made it possible to meet the main needs of the national economy and of the population for shipments. The freight turnover of the railroads comprised 421 billion t-km in 1940 and increased almost 24-fold compared to 1922.

The country's unified transport system was formed prior to World War II mainly on the basis of reconstruction and development of rail transport, the fraction of which comprised 87 percent of the total freight turnover of all types of transport in the country. However, the process of accelerated development of water, motor, aviation and pipeline transport was begun during the same period according to directives of the 25th Congress of the All-Union Communist Party (of Bolsheviks).

Extensive work was carried out to develop water transport--the Soviet Maritime Fleet was actually created. The Soviet shipbuilding industry delivered the first steamship-timber carriers with deadweight of 3,360 tons to the national economy in 1927 and began to supply the transport fleet with ships of different classes even during the early 1930s. The maritime fleet was supplemented with tankers and cargo-passenger ships. In 1940 the maritime fleet consisted of 870 transport vessels. The cargo turnover comprised almost 13 billion t-miles and the volume of shipments comprised more than 31 million tons. Almost 80 percent of foreign trade cargo was transported by our own fleet.

A great deal of attention was devoted to development of the maritime ports during this period. The ports at Leningrad, Odessa, Novorossiysk, Tuapse and Vladivostok were reconstructed; new ports were constructed at Kandalakshe, Naryan-Mar, Nagayev, Provideniye Bay and so on. Navigable exploitation of the Northern Sea Route was begun. Its western part was developed in the early 1920s and the eastern part was developed during the 1930s: from the Bering Strait to the Gulf of Kolyma and then to the mouth of the Kolyma River and to the mouth of the Lena River.

Work was begun during the pre-war years on development of a unified deepwater system in the European USRR. The Dneprov dam was constructed and the rapids that previously separated navigation along the Dnepr into two parts were eliminated; the Belomorsk-Baltic Canal, which provided transport service to the country's northwestern regions, was constructed and put into operation; the Moscow canal, which connected Moscow to the country's main river--the Volga, was constructed. Significant work was completed on reconstruction of a number of installations on the Volga-Baltic route. Work to develop the port-pier economy of river transport is also related to the same period. The pre-Revolution river transport essentially had no equipped ports; therefore, river ports were developed in a number of cities of the country. Construction of tanker barges with capacity from 500 to 12,000 tons and tugboats of increased capacity were begun on a wide scale at the same time.

The first steps were taken to develop truck and oil pipeline transport. In 1940 the country already had a significant truck fleet (1.057 million trucks). The pipeline transport network was increased by 25,000 km during the five-year plans prior to World War II. The Groznyy-Tuapse pipeline and the second sections of the Baku-Batumi, Armavir-Trudovaya, Guryev-Orsk, Ishimbay-Ufa and Makhachkala-Groznyy pipelines were turned over for operation.

The civil air fleet was supplemented with Soviet-produced machines. The length of the air lines was increased and construction of airports was begun. Soviet aviation emerged in third place worldwide.

The carrying and throughput capacity of the transportation system was at a rather high level by the beginning of World War II, which was of important significance. Transport, especially rail transport, coped successfully with its task during organization of combat operations and also evacuation of industry and of the population to the east of the country.

The attack of Nazi Germany on the Soviet Union stopped work on development and technical re-equipping of transport, although it was continued even during wartime on individual sections (that serviced the needs of the front and that supported the evacuation of enterprises to the eastern regions).

The postwar period is characterized by a turning point in development of the country's productive forces to the east, by an increase of the economic potential and by vigorous development of science and technology. This created conditions for accelerated technical re-equipping of the transportation system. The need for shipments of national economic goods increased sharply with regard to an increase of the length of shipments and to the shift of the producing sectors to the country's eastern regions.

The transportation system was developed during the postwar years mainly by concentrating efforts on the mainlines of the transportation networks in general and of rail transport in particular and also by increasing the capacity, carrying capacity and travel speed of the transport equipment. More than 71,000 km of railroads were constructed, of which 36,000 were for general purpose and 35,000 were for industrial transport. The throughput capacity of the railroads was increased sharply due to electrification. Approximately 26,000 km of double tracking and of two-track insertion pieces were constructed. The length of operated waterways was increased by 34,000 km. Approximately 60,000 meters of docks were constructed at maritime ports and more than 50,000 meters were constructed at river ports. The network of well-built highways was increased by almost 600,000 km. A total of 66,000 km of oil pipelines was put into operation.

Fundamental qualitative changes were made in all types of transport during 1960-1970. Work was carried out on a gigantic scale to replace steam traction with electric and diesel traction in rail transport and to replace steamships with motor ships having diesel power plants in maritime and river transport. The length of electrified lines was increased from 1,900 km in 1940 to 45,000 km in 1981 and that of lines serviced by diesel locomotives was increased from 300 km to 98,000 km, respectively.

Electrification of the railroads guarantees considerable conservation of fuel consumption. The specific consumption of comparison fuel for 10,000 t-km (gross) comprises approximately 41 kg for electric traction and 52 kg for diesel traction with regard to the fuel consumed by electric power stations (the corresponding index for steam traction was approximately 300 kg in the past). Replacement of steam traction with electric traction made it possible to conserve more than 55 million tons of comparison fuel expended on the entire volume of transport operations in 1980. Approximately 16 million tons of comparison fuel is now conserved annually compared to the expenditures which will be required with diesel traction at the achieved level of electrification of railroads.

The basic operating characteristics of the rolling stock of rail transport, especially during 1960-1970, were improved significantly. The average output of electric locomotives was increased 1.6-fold during this period and the output of diesel locomotives was increased 1.2-fold; the average capacity of a freight car was increased 1.35-fold. Electric locomotives operating on alternating current instead of those operating on direct current have now achieved broad introduction on the railroads.

The measures implemented to improve the reconstruction of rail cars and to equip them with roller axle boxes made it possible to increase the axle load of the rail car from 21 to 23 tf and the maximum travel speed to 90-100 km/hr. Output of closed all-metal freight cars with increased door bases and improved conditions for mechanization of loading and unloading operations and of specialized flatcars for transport of large containers has been organized and eight-axle tank cars with capacity of 120 tons have been developed for shipment of petroleum products. The production of gondolas for coal and ore shipments, of closed hopper cars for grain, cement and mineral fertilizers and of flatcars

for transport of compact automobiles that guarantee the preservation of freight and that reduce the laboriousness of loading and unloading operations is being expanded. The fraction of specialized cars comprised 30 percent in 1980 deliveries and will be increased in the future.

Along with total replacement of steam traction with electric and diesel traction, two-axle rail cars have been replaced by four-axle cars and centralized traffic control and automatic block system and computer equipment are being used extensively. The entire rail car fleet of the Ministry of Railways has been equipped with automatic brakes and automatic coupling.

Technical re-equipping of the railroads and development of advanced methods of labor have created conditions for increasing transport productivity. Labor productivity was increased by 25 percent during the 9th and 10th Five-Year Plans alone.

The postwar years are characterized by rapid rates of development and technical re-equipping of the maritime fleet. The total tonnage of the fleet is now 18.6 million tons. The average capacity of ships increased from 360 tons in 1913 to 10,640 tons in 1980. The maritime fleet has been considerably renovated, more than 80 percent consists of vessels less than 10 years old and the specific weight of ships with diesel power plants comprises 83 percent in tonnage. The speed of ships was increased and it corresponds to a worldwide level of 15-16 knots.

Fundamental qualitative changes were made during the 1970s, especially during the 10th Five-Year Plan: construction of a specialized fleet (container carriers, packet carriers, ferries and ships of different designation) was begun. The passenger fleet was supplemented with new comfortable liners, including those designed to transport passengers and motor vehicles, and also by hydrofoil ships and hovercraft.

The transport support of development of the Arctic and Far East regions was improved according to decisions of the 25th CPSU Congress. A powerful icebreaker and icebreaker-transport fleet has been developed. By improving the practice of Arctic navigation using the nuclear-powered icebreakers "Lenin," "Arktika" and "Sibir'," it has become possible to transform the western section of the Northern Sea Route from Murmansk to Dudinka to major year-round navigation.

The characteristic feature of developing the maritime ports during the 9th and 10th Five-Year Plans was development of specialized transshipping complexes that guarantee a high level of mechanization and automation of loading operations, reducing the anchorage time of ships for cargo operations and using progressive methods of shipment and handling of cargo. The specific weight of these complexes in the total volume of introduction of capacities comprised approximately 80 percent. Construction of the first unit of Vostochnyy Port for transshipment of coal, timber and production chips has been completed. Container terminals and complexes for transshipment of cargo by ships of the "Ro-Ro" class have been constructed at Leningrad, Riga, Ilichevsk, Murmansk, Arkhangelsk, Magadan and Petropavlovsk-Kamchatskiy ports to support

the developed progressive transport and production shipping systems. The first lighter carrier Danube-Sea system in Soviet maritime transport, based at the mouth of the Danube River, which permits an essentially new base for communications without transshipment, has been put into operation. Capacities have been introduced at Ventspils and at the new Yuzhnyy Port for transshipment of liquid and chemical cargo and a deepwater bulk-oil pier for acceptance of tankers with deadweight up to 200,000 tons has been introduced at Novorossiysk Port. The ferry complex at Ilichevsk, which supports rail-maritime communication between the USSR and the Peoples Republic of Bulgaria, has been developed and is operating. Connection of the mainland to Sakhalin Island in the Far East and between Central Asia and the Transcaucasus on the Caspian Sea has been provided by using ferries.

Fundamental technical reconstruction and re-equipping of river transport was carried out during the postwar years. Development of a unified deepwater system in the European USSR with a length of 6,300 km was mainly completed when the Volga-Don navigable canal, the Volga-Baltic waterway and the large hydroengineering facilities of complex designation on the Volga, Kama, Dnepr and Don Rivers were put into operation. Having high engineering parameters, they now perform more than two-thirds of the shipping work of river transport, guarantee the use of the most economical large-capacity ships and barges and create favorable prerequisites for switching large flows of coal, ore and other goods from railroads to waterways. Putting ships with diesel power plants and barges with metal hulls into operation was of important significance for development of the river fleet. The cost of shipments when using a diesel-powered pusher tug instead of a steamship is reduced by 25-30 percent, while shipment of cargo in metal barges costs 40-45 percent less than that in wooden barges. The average capacity of a self-propelled dry-cargo ship was increased from 650 to 1,670 tons, while the capacity of tankers was increased from 1,185 to 2,310 tons. The average capacity of tugboats increased from 300 to 530 horsepower. All this contributed to a significant increase of productivity and to improvement of working conditions in the fleet. As a result of using the push method in river transport, operation of non-selfpropelled vessels without crews or with reduced crew became possible. Large-series construction of self-propelled cargo ships and tankers was organized. Ships began to be constructed for mixed (river-sea) navigation, which could ply coastal maritime regions, eliminating the transshipment of cargo at estuary ports and reducing transport expenses.

The port-dock facilities, primarily in the eastern regions of the country, were fundamentally developed during the 9th and 10th Five-Year Plans. Large transshipments capacities were put into operation at Tobolsk, Omsk, Pavlodar, Novosibirsk, Krasnoyarsk, Irkutsk, Osetrovo and Khabarovsk. New ports were constructed at Surgut, Labytnanga, Nizhnevartovsk, Lesosibirsk, Yakutsk and Nizhneyansk A large volume of work was completed in development of the river ports in European regions as well.

The use of multiaxle MAZ-6422 truck trains with capacity up to 35 tons and of KamAZ-5320 truck trains for shipment of national economic goods became possible due to highway construction.

Large-capacity refrigerated trucks (with machine cooling) and small-capacity trucks (with nitrogen cooling) and also isothermal vans are being produced for better preservation of foodstuffs during shipment. Large-capacity milk tank trucks and cattle carriers will be used extensively.

One of the existing ways of increasing the efficiency of fuel utilization in motor transport is conversion of the truck fleet to diesel engines. Vehicles with diesel engines now carry more than 37 percent of the freight turnover.

Intensive development of motor transport requires considerable expansion and technical re-equipping of highway facilities. The system of financing and of material and technical support of highway construction by attraction of supplementary funds and resources is being improved for these purposes. A total of 328,000 km of paved highways, including 61,000 km of highways of statewide and republic significance, was constructed during 1961-1981 according to state plans. The length of general-purpose paved highways comprised 744,000 km by the beginning of the current year. However, there are still many unresolved problems in this area. One of the primary problems is development of a major highway system and development of a road network in the countryside. The decisions of the May (1982) Plenum of the CPSU Central Committee provided for rural construction of not less than 130,000 km of general-purpose roads and 150,000 km of intrafarm roads on kolkhozes and sovkhozes during the period 1981-1990 as one of the elements of the supply program.

Significant qualitative changes have occurred in the civil air fleet, especially during the 1970s. Whereas almost half the volume of shipments was carried by Il-18 and An-24 type turboprop aircraft prior to the 9th Five-Year Plan, three-fourths of passengers, mail and cargo were transported by Tu-154, Il-62M and Tu-134 type turbojet aircraft at the end of the 10th Five-Year Plan. The passenger service indicators were improved as a result of expanding the fleet of turbojet aircraft. Thus, their average speed increased from 620 to 730 km/hr, which saved labor resources worth millions of hours of socially useful time for the national economy.

The fleet of aircraft and helicopters is being renovated and their carrying capacity is being increased. The 350-seat wide-body Il-86 aircraft (with speed of 900-950 km/hr) has given a good account of itself.

Powerful pipeline transport has been developed in our country. Two-thirds of all fuel, all natural gas and approximately 95 percent of crude oil are delivered to consumers through major pipelines. Pipeline transport has emerged to second place after rail transport in the volume of freight turnover.

The USSR has the world's largest network of major gas pipelines with respect to average pipe diameter, combined into a Unified Statewide Gas Supply System (YeSGS). It includes more than 130,000 km of major gas pipelines and trunk lines from them and the total output of its compressor stations has reached 20 million kW, which is double the output of the Krasnoyarsk GES.

Among the other progressive directions for development of the country's Unified Transport System is extensive development of container and packet shipments,

which guarantee an increase of labor productivity in auxiliary transport operations, complex mechanization of loading and unloading operations, reduction of consumption of materials for packing freight and improvement of the transshipment process. Up to 20 million rubles is saved in the national economy with shipment of one million tons of freight in containers, up to four million rubles is saved when this volume is shipped in packets and 1,500 and 1,100 workers, respectively, are released. The volume of container shipments increased 1.8-fold and the volume of packet shipments increased 3.3-fold during the 9th and 10th Five-Year Plans and reached 77 and 265 million tons, respectively, in 1981.

There is a close tie between the development of production and transport. On the one hand, the increase of production, structural changes in the national economy and territorial changes in plant disposition have a decisive influence on the operation of transport, its scales and the role of each type of transport in freight and passenger shipments and, on the other hand, transport itself actively and directly affects the rates, scales and direction of development of the national economy and the efficiency of all social production.

Rail transport played an enormous role in supporting the economic ties of the union republics and in dispersion of the country's productive forces. Prior to the October Socialist Revolution, the republics of Central Asia and Kazakhstan had no direct rail communications with vast regions of Siberia and the Far East. Communications were roundabout--through Chelyabinsk, Kuybyshev and Orenburg. Construction of the Turkish-Siberian Railroad, 1,450 km long in 1922-1932 guaranteed direct communications between these republics and the eastern regions, which contributed to development of the economic ties between them. With construction of this railroad, the Central Asian Republic rec Siberian grain and timber and Kuznetsk coal, while cotton, rice and oil began to be delivered to Siberia. The Central Asian republics, earlier forced to cultivate their own grain crops (due to isolation from grain-growing regions), gained the opportunity of using plowed land mainly for cotton. Conditions for bringing the natural resources of Eastern Kazakhstan into economic circulation became possible with the appearance of the Turkish-Siberian Railroad and mining of richest Chulak-Tauskiy phosphorite and polymetal ore deposits was begun.

The Petropavlovsk-Tselinograd-Karaganda-Berlik Mainline Railroad, constructed during Soviet power, linked the Central Asian republics and Kazakhstan through the Siberian Mainline to Western Siberia and the Urals, while the Troitsk-Kizlyar Mainline provided communications of the Urals and Kazakhstan with the Lower Volga region, the Northern Caucasus and the Transcaucasus.

Transport had an enormous effect on implementation of Lenin's national policy. There were generally no railroads in the present-day Kirgiz and Tadzhik SSR during pre-Revolutionary Russia, while their length was extremely short in Kazakhstan, Uzbekistan and other republics. The transport system was developed at especially high rates in the union republics after the October Socialist Revolution, which contributed to a significant degree to elimination of the economic and cultural lag of the national republics.

Development of the vast tracts of virgin and forest lands of Kazakhstan within short periods made it necessary to construct the Southern Siberian (Tselinograd-Pavlodar-Barnaul-Artyshta) and the Central Siberian (Kustanay-Kokchetav-Irtysh-Karasuk-Kamen'-na-Ob'--Altay) Mainline Railroads with a number of branch lines from them. As a result, these regions were advanced to the largest grain shippers during the past few years, having outstripped a number of the country's old graneries.

Water transport, especially in regions of new industrial development, played an important role in development of the productive forces at all phases of socialist construction. Thus, development of the Western Siberian oil and gas complex during the first years, prior to construction of the Tyumen'-Tobolsk-Surgut Railroad, was completely supported by rail transport. All shipments for the Norilsk Mining and Metallurgical Combine were made by maritime and river transport from the moment of its development.

The length of railroads and paved highways to previously economically lagging republics, in which party and government policy directed toward the economic and cultural rise of all union and autonomous republics on the basis of combining the interests of the entire country with those of of each of them, was clearly manifested, increased at higher rates during Soviet power. The accelerated development of transport in these republics contributed to equalization of the levels of the economic, sociopolitical and cultural developments.

Whereas the total length of railroads throughout the entire Soviet Union doubled by 1980 compared to 1913, it increased almost sevenfold in Kazakhstan, fivefold in Tadzhikistan and threefold in Uzbekistan. The railroads in Kirgizia have been renovated.

The highway network in the Kazakh, Turkmen, Tadzhik, Kirgiz, Uzbek, Armenian and Azerbaijan SSR was essentially created anew. For example, the length of highways in the RSFSR increased 18-fold in 1980 compared to 1913 and fourfold compared to 1940; the figure was 30-fold and almost fourfold, respectively, in the Moldavian SSR.

The transport network was developed at higher rates in previously economically lagging republics. Thus, whereas the density of the transport network increased approximately threefold throughout the USSR in 1980 compared to 1913, it increased almost sixfold in the Uzbek SSR, elevenfold in the Kirgiz and Tadzhik SSR and almost eightfold in the Kazakh SSR.

Extensive work was carried out during the 9th and 10th Five-Year Plans on transport support of the eastern regions of the RSFSR and primarily of the entire Western Siberian oil and gas complex. The Tyumen-Surgut Rail Line was constructed and put into operation and construction of the Surgut-Orengoy line was completed. The total length of all railroad tracks constructed for the needs of the oil and gas complex, including spur tracks, is almost 1,800 km. More than 1,550 km of highways were constructed during these same years, the navigable conditions of the rivers were improved and river ports were developed. The river fleet was supplemented with new ships. The region's transport system now mainly supports the needs of the oil and gas complex in

cargo shipment. The large pipeline network completely supports exports of crude oil and gas.

Large-scale operations are being conducted in construction of the Baykal-Amur Mainline Railroad, which will play a decisive role in the national economic development of the adjacent territory of 1.5 million km^2. The BAM will fundamentally improve the transport communications of Siberia and the Far East and will contribute to implementation of the task provided by the supply program.

The 26th CPSU Congress posed important and complex tasks in development of the country's transport. The freight turnover of all types of transport should be increased by 22 percent and passenger turnover should be increased by 16 percent during the 11th Five-Year Plan. To guarantee the planned volumes of shipping operations by transport, the 1981-1985 plan provides for implementation of large-scale measures for further development of the material and technical base of all types of transport, an increase of the traffic and carrying capacity of the Unified Transport System, an also creation of the necessary technological reserves of capacities to guarantee functional maneuverability and reliability of the transport complex. Therefore, higher growth rates of capital investments and resource support of the needs of transport are planned for the current five-year plan. Capital investments directed toward development of the material and economic base of rail transports are being increased by more than 33 percent compared to the previous five-year plan and comprise almost 22 billion rubles with an increase of capital investments by 12-15 percent in the national economy. As a result, the specific weight of rail transport in the total capital investments of the transport system will increase significantly. Capital investments in other types of transport will also increase, although to a lesser extent.

A total of 6,000 km of rail lines will be electrified, 5,000 km of double tracking will be constructed and more than 15,000 km of track will be equipped with automatic block systems and centralized traffic control during 1981-1985. The transport network and the transport junctions in Siberia and the Far East, specifically the zone of the Western Siberian oil and gas complex, will be developed at advancing rates. The BAM will become operational during the next decade.

Measures will be undertaken to increase the carrying capacity of the Western Siberian Mainline Railroad (between the Kuzbass and the Urals and between the Urals and the central regions of the country), which will permit assimilation of the increasing flows of national economic goods in east-west traffic and will accelerate the development of the eastern regions of the country. The Surgut-Orengoy Railroad will become operational. Other measures to improve the transport service of the formed and developing large oil and gas complex in Northwestern Siberia will be implemented.

It is planned to construct 32 transshipment complexes, including 26 specialized complexes with a total capacity of 26.4 million tons, in maritime transport. The specific weight of specialized complexes at maritime ports will reach 40 percent in 1985 compared to 34 percent in 1980. The length of mechanized docks

will be increased by almost 9,000 meters. A total of 12,400 km of oil pipelines and 39,000 km of gas pipelines will be constructed during the five-year plan. The volume of work on construction of gas pipelines should be almost doubled during this five-year plan compared to the last five-year plan. Formation of a multibranch pipeline system for delivery of natural gas from the Tyumen field to the Urals and to the European USSR, including its western and southern regions, will be continued on an unprecedented scale. Soviet gas will begin to be exported to Western Europe in 1984 through the large pipelines under construction.

Considerable funds are being directed toward development of the highway system; accelerated development of the support major highway system, which guarantees communications between the large economic regions and populated points of the country, has been provided. A total of 49,000 km of new highways will appear during 1981-1986.

Further technical re-equipping of the rolling stock of all types of transport will be accomplished during the current five-year plan. More powerful AC electric locomotives with automatic regulation of traction conditions and electric braking will appear in rail transport. The rail car fleet will be expanded by 354,000 units due to new deliveries. The freight capacity of the rail cars will also be increased. The number of specialized rail cars with higher capacity utilization factor will increase.

The 11th Five-Year Plan envisions supplementation and renovation of the maritime and river fleet, specifically, with container carriers, roll on-roll on ships, timber and packet carriers and mixed navigation (river-sea) ships, while the river fleet will be supplemented with non-self-propelled vessels to support shipments of cargo by the pusher tug method. An increase of the freight capacity of the truck fleet and more extensive use of specialized rolling stock are envisioned. Its specific weight will be brought up to 75 percent in 1985 compared to 53 percent in 1980. Freight capacity will be increased by using large-capacity truck trains and also by expanding the use of trailers and semitrailers, the output of which will increase 2-3-fold. Truck transport will have a greater number of vehicles operating on diesel fuel (13 percent in 1980 and 17 percent in 1985). Conversion of gasoline-powered vehicles to diesel fuel and also to compressed natural gas will permit a 30 percent reduction of fuel consumption. Moreover, conversion to diesel engines will significantly reduce environmental pollution.

Significant renovation of the civil air transport fleet is planned during 1981-1985 and for the period up to 1990. New Il-86 and An-72 type aircraft and a number of new helicopters will begin to be operated and development of new major aircraft is envisioned. It is planned to construct 54 takeoff-landing strips at airports to support efficient operation of the new aircraft fleet. Introduction of automated traffic control to increase aircraft safety and flight regularity will be continued.

It is necessary that the work experience of the leaders of Leningrad, Odessa, Sverdlovsk, Moscow and other transport enterprises in the use of new methods of labor, coordination and tie-in of the operation of all transport enterprises contained in the country's Unified Transport System achieve wide distribution.

L. I. Brezhnev, in his annual report at the 26th CPUS Congress, talking about the operation of transport, emphasized: "taking the seriousness and scale of the problems that have developed in transport into account, we have concluded that it can be solved only on the basis of a long-term complex program."[3] Intensification of the coordination of work and development of all types of transport--rail, motor and air, maritime and river and also pipeline--should be provided for in the program. The problem of reducing transport expenses requires important attention. The way to solving it is efficient disposition of productive forces, development of optimum schemes of freight traffic volumes and elimination of counter shipments.

The transport ministries and freight shippers should support development and implementation of measures to improve the organization and technology of the shipping process, to increase production discipline and to improve methods of monitoring and of the control system, specifically, by extensive development of an automated shipping process management system. These measures will contribute to more efficient use of transport equipment, productive capacities and reserves and to overcoming difficulties in transport servicing of the national economy and of the population within the shortest period.

A committee supervised by USSR Gosplan is now working out a long-term complex program for radical solution of the country's transport problems. Its main task is to complete the creation and development of a highly efficient transport system that guarantees total quantitative and more qualitative satisfaction of the growing needs of the population and of the national economy for shipments.

Prominent scientists, managers and specialists of different sectors of the national economy, linked to transport, are being recruited to work out the program. The development of sectors of the national economy is being mutually tied in to supporting their needs for shipments so as not to permit a lag in any link and so as to guarantee functioning of the entire complex of transport developments in the country. The program will be included in the plan for economic and social development of the USSR.

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[3] "Materialy XXVI s"yezda KPSS" [Materials of the 26th CPSU Congress], Moscow, Politizdat, 1981, p 39.

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TRANSPORTATION STATISTICS FOR SELECTED YEARS

Moscow VESTNIK STATISTIKI in Russian No 8, 1982 pp 71-80

[Article on transportation and communications in USSR for selected years]

[Excerpts] I. In Honor of the 60th Anniversary USSR--Transportation and Communications in the USSR

"Transportation of course has always played an important role. But its significance is increasing even more under the conditions of the unprecedented movement of industry to Siberia and to the Far East and due to intensification of specialization and cooperation." (L. I. Brezhnev)

Table 1. Length of Means of Communication Throughout USSR (for end of year, thousands of kilometers)

	1922	1940	1965	1981
(1) Эксплуатационная длина железных дорог МПС (2)	71,9	106,1	131,4	142,8
в т. ч. электрифицированных	—	1,9	21,9	44,8
Внутренние водные судоходные пути (3)	53,9	108,9	142,7	140,0
(4) в т. ч. с обстановкой пути	...	101,3	127,1	131,2
Автомобильные дороги с твердым покрытием (включая ведомственные) (5)	19,6	143,4	459,1	977,0
Воздушные линии (без перекрывающихся участков) (6)	—	146,3	481,1	1019,0
в т. ч. в пределах территории СССР (7)	—	143,9	435,0	801,5

Key:

1. Operating length of railroads of Ministry of Railways
2. Including electrified
3. Inland navigable waterways
4. Inlcuding those with arrangement of route
5. Paved highways (including service roads)
6. Air lines (without overlapping sections)
7. Including those within the USSR

Table 2. Operational Length of Railroads of Ministry of Railways Through Union Republics (for end of year, thousands of kilometers)

	1922	1940	1965	1981
(1)				
СССР	71,9	106,1	131,4	142,8
РСФСР (2)	48,01	58,68	75,44	83,31
Украинская ССР (3)	13,67	20,10	21,73	22,65
Белорусская ССР (4)	2,07	6,44	5,35	5,51
Узбекская ССР (5)	1,41	1,91	2,71	3,46
Казахская ССР (6)	2,73	6,58	12,47	14,27
Грузинская ССР (7)	0,88	1,13	1,41	1,42
Азербайджанская ССР (8)	0,84	1,21	1,73	1,90
Литовская ССР (9)		2,01	2,02	2,03
Молдавская ССР (10)	0,10	0,82	1,03	1,15
Латвийская ССР (11)		3,21	2,82	2,38
Киргизская ССР (12)	0,02	0,22	0,37	0,37
Таджикская ССР (13)	0,11	0,25	0,26	0,47
Армянская ССР (14)	0,36	0,40	0,55	0,75
Туркменская ССР (15)	1,67	1,75	2,10	2,12
Эстонская ССР (16)		1,39	1,40	1,01

Key:

1. USSR
2. RSFSR
3. Ukrainian SSR
4. Belorussian SSR
5. Uzbek SSR
6. Kazakh SSR
7. Georgian SSR
8. Azerbaijan SSR
9. Lithuanian SSR
10. Moldavian SSR
11. Latvian SSR
12. Kirgiz SSR
13. Tadzhik SSR
14. Armenian SSR
15. Turkmen SSR
16. Estonian SSR

Table 3. Freight and Passenger Shipments by Individual Types of Transport

	1922	1940	1965	1981
Перевозки грузов, млн. тонн (1)				
(2)				
Железнодорожный	44,6	605,1	2415,3	3762,2
Морской (3)	4,3	32,9	119,3	223,2
Речной (4)	5,5	73,9	269,4	594,5
Автомобильный (народного хозяйства) (5)	9,1	858,6	10746,0	25906,1
Воздушный (включая почту) (6)	—	0,1	1,2	3,1
Перевозки пассажиров, млн. человек (7)				
Железнодорожный	91,1	1377,4	2301,2	3576,4
Морской	1,2	9,7	37,2	54,5
Речной	...	73,4	133,9	146,0
Автомобильный (автобусы) (8)	0,0	590,0	18656,6	42950,9
Воздушный (9)	--	0,4	42,1	108,9

Key:

1. Freight shipments, million tons
2. Rail
3. Maritime
4. River
5. Motor (of national economy)
6. Air (including mail)
7. Passenger shipments, million persons
8. Motor (busses)
9. Air

Table 4. Dispatch of Freight by General-Purpose Rail Transport Throughout USSR and Union Republics (million tons)

	1922	1940	1965	1981
(1)				
СССР	44,6	805,1	2414,3	3761,7
РСФСР (2)	22,7	533,9	1415,8	2065,3
Украинская ССР (3)	18,6	200,0	661,3	982,7
Белорусская ССР (4)	0,8	15,0	34,0	102,0
Узбекская ССР (5)	0,4	5,4	33,0	67,8
Казахская ССР (6)	0,3	15,5	130,3	314,8
Грузинская ССР (7)	0,6	5,2	23,7	39,0
Азербайджанская ССР (8)	0,8	7,7	28,9	37,8
Литовская ССР (9)		3,6	10,8	27,8
Молдавская ССР (10)	0,12	1,1	9,4	15,3
Латвийская ССР (11)		5,6	11,4	20,9
Киргизская ССР (12)		2,0	5,1	8,4
Таджикская ССР (13)	0,01	1,8	4,5	7,3
Армянская ССР (14)	0,05	1,4	8,3	19,1
Туркменская ССР (15)	0,2	3,6	14,9	27,4
Эстонская ССР (16)		3,3	17,9	26,1

Key:

1. USSR
2. RSFSR
3. Ukrainian SSR
4. Belorussian SSR

[Key continued on following page]

[Key continued from preceding page]:

5. Uzbek SSR
6. Kazakh SSR
7. Georgian SSR
8. Azerbaijan SSR
9. Lithuanian SSR
10. Moldavian SSR
11. Latvian SSR
12. Kirgiz SSR
13. Tadzhik SSR
14. Armenian SSR
15. Turkmen SSR
16. Estonian SSR

II. Urban Passenger Electric Transport

Table 1. Urban Passenger Electric Transport Throughout the USSR and Union Republics for 1981 (for end of year)

	Трамвай (1)			Троллейбус (2)			Метрополитен (3)		
	(4)	(5)	(6)						
(7)									
СССР	9269,3	20864	8196,8	14521,7	24 583	8905,2	356,2	4834	3974,1
РСФСР (8)	6179,9	11000	5676,6	7651,9	12 709	4693,6	230,1	3 957	3114,9
Украинская ССР (9)	1996,3	1811	1742,5	3238,9	6 322	2351,1	15,6	707	473,1
Белорусская ССР (10)	141,9	348	153,2	606,4	1 275	485,3	—	—	—
Узбекская ССР (11)	249,3	143	127,9	321,6	687	146,2	15,5	105	85,6
Казахская ССР (12)	227,0	318	115,4	441,4	540	123,6	—	—	—
Грузинская ССР (13)	100,1	131	35,7	358,3	460	117,4	18,8	125	142,8
(14) Азербайджанская ССР	91,0	125	38,3	318,4	401	86,6	18,6	108	136,9
Литовская ССР (15)	—	—	—	207,4	460	261,6	—	—	—
Молдавская ССР (16)	—	—	—	262,2	543	201,7	—	—	—
Латвийская ССР (17)	130,0	386	203,6	195,7	415	209,0	—	—	—
Киргизская ССР (18)	—	—	—	139,3	216	77,5	—	—	—
Таджикская ССР (19)	—	—	—	148,5	241	82,1	—	—	—
Армянская ССР (20)	96,0	178	28,6	250,8	398	72,1	7,6	32	17,5
Туркменская ССР (21)	—	—	—	95,9	62	21,2	—	—	—
Эстонская ССР (22)	37,8	124	74,8	65,0	161	63,0	—	—	—

[1] For the year.

Key:

1. Streetcar
2. Trolleybus
3. Subway
4. Length of single operating track, km
5. Number of passenger cars, units
6. Passengers transported, million persons
7. USSR
8. RSFSR
9. Ukrainian SSR
10. Belorussian SSR
11. Uzbek SSR
12. Kazakh SSR
13. Georgian SSR
14. Azerbaijan SSR
15. Lithuanian SSR
16. Moldavian SSR
17. Latvian SSR
18. Kirgiz SSR
19. Tadzhik SSR
20. Armenian SSR
21. Turkmen SSR
22. Estonian SSR

Table 2. Urban Passenger Electric Transport for Individual Cities

	Трамвай (1)			Троллейбус (2)			Метрополитен (3)		
	протяженность эксплуатационного одиночного пути, км (4)	число пассажирских вагонов, единиц (5)	перевезено пассажиров, млн. человек[1] (6)	протяженность эксплуатационной одиночной линии, км	число пассажирских машин, единиц	перевезено пассажиров, млн. человек[1]	протяженность пути в двухпутном исчислении, км	число пассажирских вагонов, единиц	перевезено пассажиров, млн. человек[1]
(7) СССР	9269,3	20864	8196,8	14521,7	24593	8995,2	356,2	4834	3974,1
в том числе (8) по городам:									
Алма-Ата (9)	73,7	116	50,4	211,0	282	73,8	—	—	—
Ашхабад (10)	—	—	—	95,9	62	21,2	—	—	—
Баку (11)	69,5	98	34,7	196,7	172	53,7	18,6	108	136,9
Вильнюс (12)	—	—	—	109,3	277	185,3	—	—	—
Горький (13)	197,6	463	140,7	193,0	246	48,9	—	—	—
Днепропетровск (14)	157,8	475	121,9	182,6	306	97,5	—	—	—
Донецк (15)	125,5	205	106,2	141,5	306	140,1	—	—	—
Душанбе (16)	—	—	—	108,5	188	72,6	—	—	—
Ереван (17)	96,0	178	28,6	201,3	365	62,4	7,6	32	17,5
Казань (18)	139,9	423	177,1	126,5	265	92,2	—	—	—
Киев (19)	276,2	923	405,4	221,9	1 039	377,6	28,3	320	298,0
Кишинев (20)	—	—	—	143,2	374	141,6	—	—	—
Куйбышев (21)	169,1	456	141,1	179,1	278	67,9	—	—	—
Ленинград (22)	655,9	2 072	878,0	662,6	1 171	469,4	66,1	990	737,7
Минск (23)	56,4	163	91,5	312,8	786	277,8	—	—	—
Москва (24)	466,8	1 215	498,2	1128,8	2 362	765,7	184,0	2 967	2377,2
Новосибирск (25)	176,6	465	159,0	235,6	315	95,4	—	—	—
Одесса (26)	215,6	481	212,0	135,3	292	117,7	—	—	—
Омск (27)	108,2	183	73,7	107,6	150	46,3	—	—	—
Пермь (28)	118,7	250	114,4	67,8	102	66,6	—	—	—
Рига (29)	112,6	321	164,3	195,7	418	209,0	—	—	—
Свердловск (30)	166,8	425	229,1	109,4	236	111,3	—	—	—
Таллин (31)	37,8	124	74,8	65,0	161	63,0	—	—	—
Ташкент (32)	219,3	443	128,0	237,7	377	92,5	15,5	105	88,6
Тбилиси (33)	100,1	131	35,7	88,5	221	55,7	18,8	125	142,8
Уфа (34)	150,8	385	119,9	115,2	201	62,9	—	—	—
Фрунзе (35)	—	—	—	145,5	204	75,1	—	—	—
Харьков (36)	231,8	706	239,7	215,0	582	200,0	17,3	187	175,4
Челябинск (37)	149,6	360	164,1	158,4	374	146,9	—	—	—

[1] For the year.

[Key on following page]

[Key continued from preceding page]:

1. Streetcar
2. Trolleybus
3. Subway
4. Length of single operating track, km
5. Number of passenger cars, units
6. Passengers transported, million persons
7. USSR
8. Including by cities
9. Alma-Ata
10. Ashkhabad
11. Baku
12. Vilnius
13. Gorkiy
14. Dnepropetrovsk
15. Donetsk
16. Dushanbe
17. Yerevan
18. Kazan
19. Kiev
20. Kishinev
21. Kuybyshev
22. Leningrad
23. Minsk
24. Moscow
25. Novosibirsk
26. Odessa
27. Omsk
28. Perm
29. Riga
30. Sverdlovsk
31. Tallin
32. Tashkent
33. Tbilisi
34. Ufa
35. Frunze
36. Kharkov
37. Chelyabinsk

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